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THE SAN FRANCISCO BAY - DELTA WASTEWATER AND RESIDUAL SOLIDS MA--ETC(U)

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THE SAN FRANCISCO BAY - DELTA WASTEWATER AND RESIDUAL SOLIDS MANAGEMENT STUDY

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VOLUME V

Technical Appendix

Environmental Impact Assessments for Eight Representative Sites

PBQ&D, Inc.
San Francisco

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The San Francisco Bay - Delta Wastewater and Residual Solids Management Study

Volume V - Technical Appendix
Environmental Impact Assessments For Eight Representative Sites

Prepared for:
The San Francisco District
U. S. Army Corps of Engineers

P B Q & D, Inc.
San Francisco

December 1972

The San Francisco-Bay-Delta
Wastewater and Residual Solids
Management Study

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Acknowledgements

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SECTION A

A. DESCRIPTION OF PROJECT

1 - Background

Discharge of wastewaters into the ocean, estuaries and inland waterways by communities and industries has been common in the past and has been justified in short-range economic terms. However, the subsequent degradation of waterways by these discharges has aroused deep and sincere public concern. Local, regional, state and federal agencies have responded by implementing new standards for discharges to protect and recover these public waters for maximum beneficial utilization. Many programs and proposed standards outlining substantial improvements in degree of treatment required for municipal and industrial wastewater effluents have been promoted and in some cases implemented.

Coupled with this demand for higher quality wastewater discharges is a growing concern for the conservation, reclamation and reuse of all natural resources. Increasing demands by growing communities for higher quality urban water supplies will continue to deplete existing surface and subsurface water sources which now supply municipal, agricultural, recreational, fish, wildlife and other needs. Unless it is realized that treated wastewater can and must eventually be returned to the hydrologic system, extensive local and regional areas will be directly affected by increasing and conflicting water demands and water shortages.

Recognizing the need for comprehensive wastewater and residual solids management within the total resource system, the Corps of Engineers has initiated the Pilot Wastewater Management Program in five metropolitan regions throughout the United States: the Boston Region in the Merrimack River Basin; the Detroit Region in seven river basins draining into Lake Erie; the Cleveland-Akron Region; the Chicago Region in several watersheds draining into the south end of Lake Michigan; and the San Francisco Bay-Delta Region. In July, 1971, the Corps of Engineers, San Francisco District, completed a feasibility report on wastewater management alternatives in the San Francisco Bay and Sacramento- San Joaquin Delta Area which explored the problem of regional wastewater management and outlined the need for a more detailed study. This detailed study was undertaken by the Corps with consultant support in the current survey-scope work which is part of the San Francisco Bay-Delta Wastewater and Residual Solids Management Study.

In many areas of the San Francisco Bay-Delta Region there exists the possibility to utilize wastewaters and residual solids in improving existing conditions; by providing replacement irrigation waters which would release more

potable water from that demand, by increasing the productivity of range and forest lands, by providing fertilizers and nutrients for crops, by enhancing and improving flows in waterways, by replenishing and enhancing wildlife, fish and recreational areas and by other productive applications. Critical water shortages exist or are anticipated in certain areas in the Region, and wastewaters reclaimed through land application could be applied in these areas to meet these needs.

This study presents the results of the environmental assessment of selected representative wastewater sites. It is based on reconnaissance level field inspection of the sites, supporting office studies, and a review of pertinent and updated information presented in previous reports of the Wastewater and Residual Solids Management Study. This study will provide basic materials required in the preparation of an environmental impact statement on the application of wastewaters generated within the 12 counties of the Region to selected sites.

2 - The Land Application Alternative

The general objective of the regional wastewater water quality management program is to determine the most economical and beneficial use of wastewaters compatible with existing and future land uses and the recognized need to protect and enhance the quality of various elements of the environment. With increasing population levels, the expansion of high density urban land uses, and rapidly expanding economic activity, increased pressure has been applied to our water, air, and land resources. This has resulted in a demand for greater reuse of all resources and effective measures to protect recognized environmental values.

Although the disposal of wastewater to the marine, estuaries, or fresh water environments is considered a viable alternative to land application, progressively higher levels of wastewater treatment will generally be required. Associated with these higher levels of treatment will be greater quantities of sludges which also have disposal problems. Land application of wastewater and sludges by irrigation is based on using the soil column with its vegetative or crop cover as a treatment unit process and has the following advantages:

1. It does not require expensive tertiary treatment.
2. The volume and type of sludges associated with conventional secondary levels of treatment can be utilized beneficially through the same facilities provided for the wastewater applications.
3. It presents an opportunity for recycling the water and many of its constituents.

The concept of wastewater reuse offers a number of attractive opportunities for environmental enhancement. Maximum use of the natural processes to accomplish purification of wastewater is in keeping with the goal of management of all resources - air, land and water - as a total recirculating system. Potential opportunities for environmental benefits include the replacement of higher quality water resources presently committed to less demanding uses, the reduction of diversions from natural streams, the improvement of groundwater levels through groundwater recharge, and the increase in wildlife carrying capacities through improved vegetative covers.

3 - The Study Area

The area selected for investigation and identification of suitable sites for potential land application of treated wastewater and residual solids originating in the 12-county source area is shown in Figure V-A-1. This 39-county area encompasses about 70,000 square miles and extends from the Cascade Mountains in the north to the Tehachapi Mountains in the south and from the Sierra Nevada Mountains in the east to the Pacific Ocean in the west. It includes all or major portions of seven hydrologic sub-regions with climates ranging from arid to maritime.

The water resources of the San Francisco Bay, the Sacramento and San Joaquin Rivers and the Delta support many unique and important natural resources of regional and national interest. Protection of these resources has resulted in a continuing effort to effectively manage wastewaters from all sources.

The Study Area also includes a large and highly successful economy based on the irrigation of over seven million acres of agricultural crops. The irrigated area is expected to grow to about nine million acres by the year 2020 if adequate water supplies can be developed. The gradual deterioration of the quality of available water, particularly groundwater, is a great concern throughout the Study Area. Increased diversions of upstream waters and the introduction of concentrated return flows have lowered the quality of water available to many downstream users.

a. Drainage

The seven hydrologic sub-basins of the Study Project Area are shown in Figures V-A-2 and V-A-3. They consist of the following:

1. San Francisco Bay
2. Sacramento River

3. Sacramento-San Joaquin Delta - Central Sierra-Consumnes, Mokelumne, and Calaveras Rivers
4. San Joaquin River
5. Uulare Lake, Kings and Kern Rivers
6. North Coastal
7. Central Coastal.

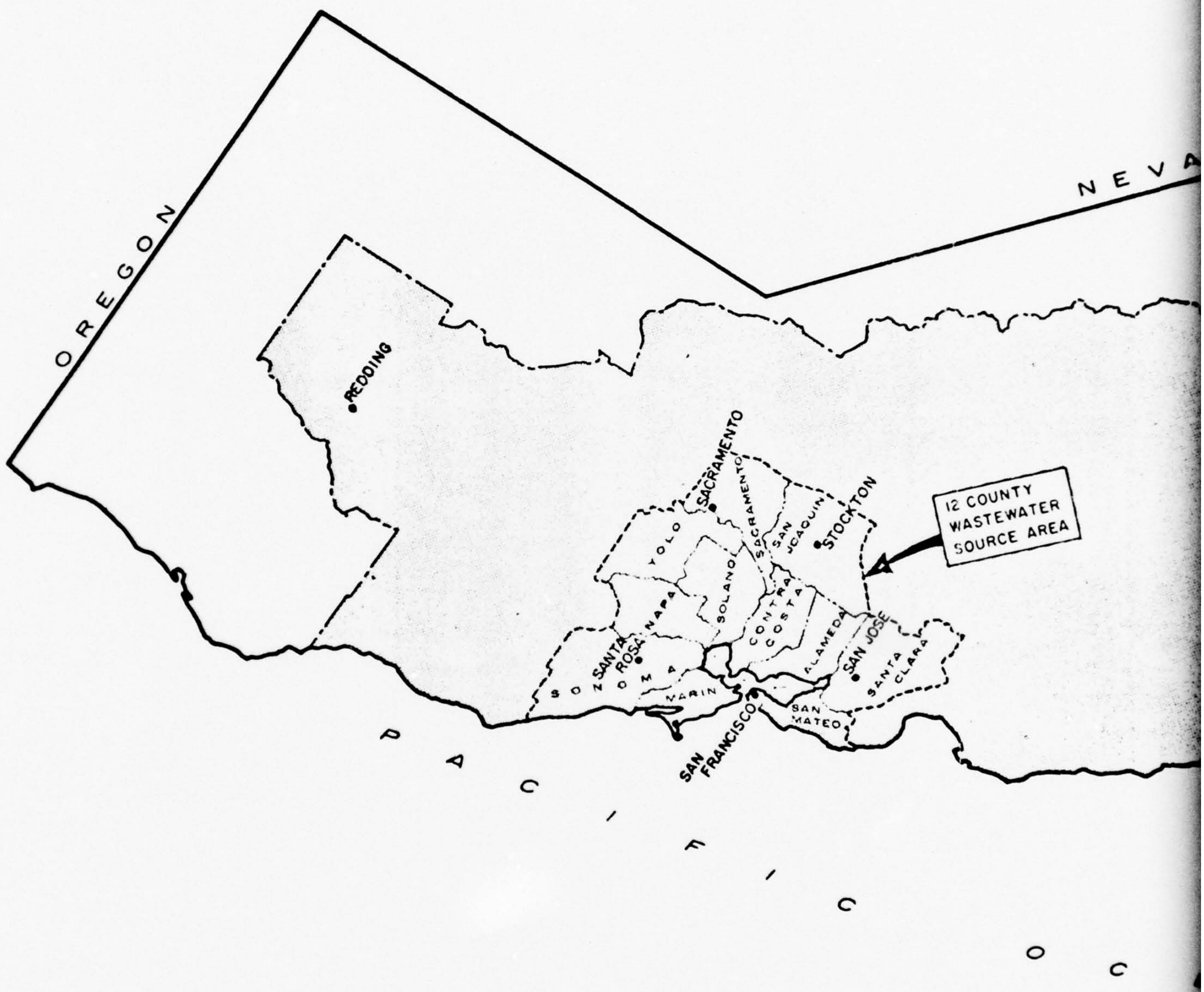
The second, third, fourth, and fifth listed sub-basins comprise California's great Central Valley (Figure V-A-4). The Central Valley together with the San Francisco Bay sub-basin constitutes one great drainage basin for all flows going through the Golden Gate with the exception of (1) the Tulare Lake sub-basin which is actually a closed interior basin separated from the San Joaquin River drainage by a low elevation divide, and (2) the Goose Lake closed basin in north-central Modoc County and southwest Lake County (Oregon) which is topographically considered the northernmost extension of the Sacramento River drainage and specifically of the Pit River drainage tributary. The San Francisco Bay-Delta constitutes the estuarine "mouth" of this great Central Valley drainage basin.

The 12-county waste source region encompassing the estuarine system occupies about 10,000 square miles. About 80 percent of this area is immediately tributary to this estuarine system. The remaining portions drain directly to the Pacific Ocean through many small minor stream channels or through other more important streams and water bodies. The most significant examples of these are the Russian River basin in Sonoma County and the Tomales Bay drainages of Marin County.

b. Geology, Geomorphology and Topography

The Study Region lies wholly within the Pacific Coast mountain ranges system, one of the major landform regions of North America. The Study Region specifically encompasses parts of three geomorphic provinces of California, the Coast Ranges, the Great or Central Valley, and the Cascade-Sierra Nevada Ranges (Refs. 1,2).

"The Coast Ranges comprise a series of nearly parallel mountain ranges and valleys that trend in a northwesterly direction and rise to elevations of over 4000 feet. This trend is largely controlled by the geologic structure of the underlying rocks, which is dominated by the active San Andreas Fault System running nearly the full length of the Coast Ranges" (Ref. 1). The fault system in the San Francisco Bay-Delta area is shown in Figure V-A-5. The Coast Ranges in the Study Region include three rather generalized physiographic regions; (1) the highlands consisting of rolling hills to fairly rugged mountains, (2) the intermountain valleys, most of which are youthfull and V-shaped, and (3) the San


OREGON
NEVA
REDDING
SACRAMENTO
YOLO
SACRAMENTO
SAN JOAQUIN
STOCKTON
12 COUNTY
WASTEWATER
SOURCE AREA
SOLANO
NAPA
SANTA ROSA
SONOMA
MARIN
CONTRA COSTA
ALAMEDA
SAN JOSE
SANTA CLARA
SAN MATEO
SAN FRANCISCO
PACIFIC OC

2

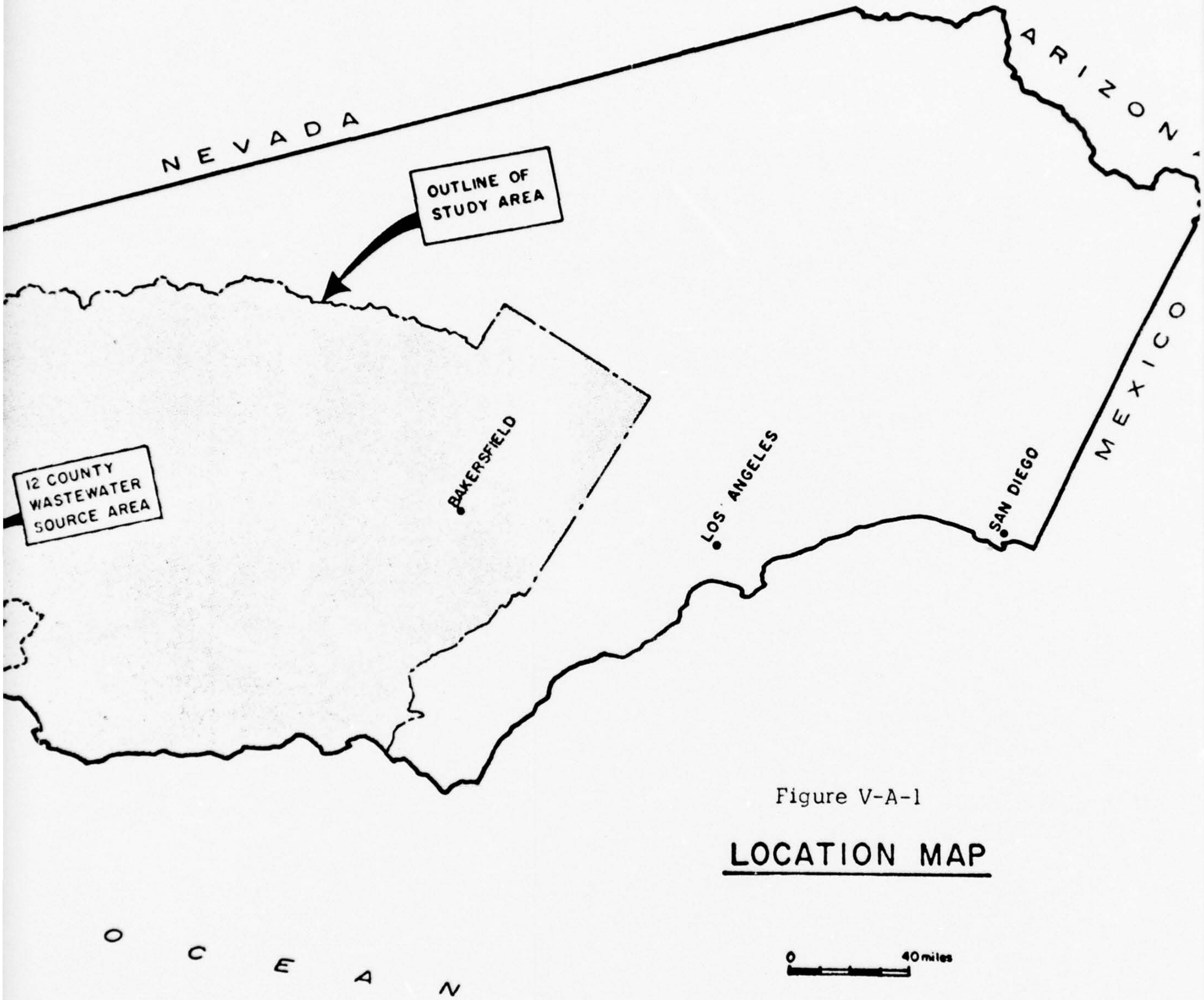


Figure V-A-1

LOCATION MAP

(From Vol. II, Fig. II-A-1, Pg. A-2)

Figure V-A-2

BASIN PLANNING AREAS

1 A - KLAMATH RIVER
1 B - NORTH COASTAL
2 - SAN FRANCISCO BAY
3 - CENTRAL COASTAL
4 A - SANTA CLARA RIVER
4 B - LOS ANGELES RIVER
5 A - SACRAMENTO RIVER
5 B - SACRAMENTO - SAN JOAQUIN DELTA
5 C - SAN JOAQUIN
5 D - KING and KERN RIVERS and TULARE LAKE
6 A - LAHONTAN (NORTH)
6 B - LAHONTAN (SOUTH)
7 A - COLORADO RIVER (WEST)
7 B - COLORADO RIVER (EAST)
8 - SANTA ANA RIVER
9 - SAN DIEGO

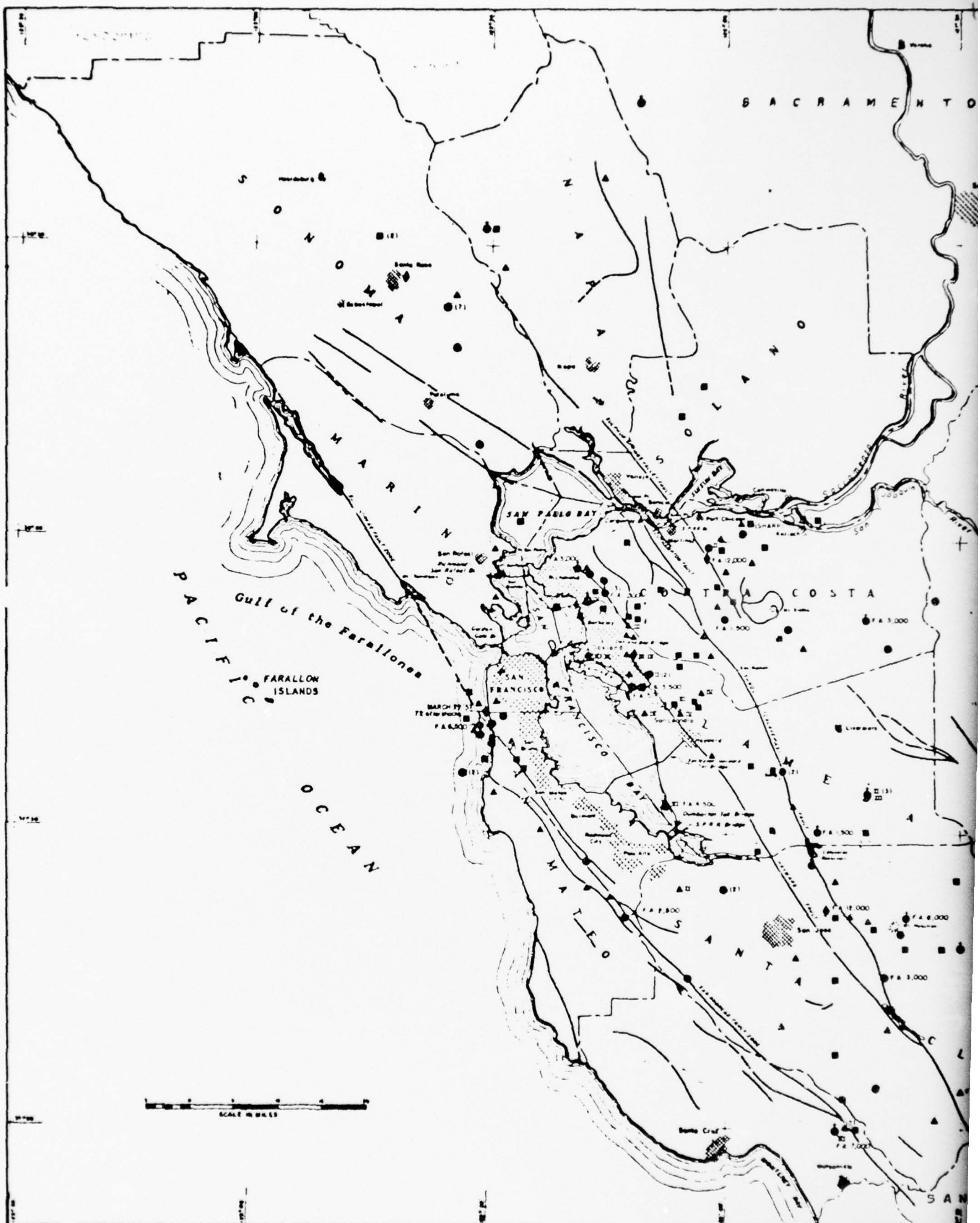
BASIN PLANNING AREAS AS DESIGNATED
THE CALIFORNIA STATE WATER
RESOURCES CONTROL BOARD
(From Ref. 1, Vol. 2, Fig. A-12)

Figure V-A-3
(From Ref. 1, Vol. 1, Fig. A-15)

HYDROGRAPHIC STUDY AREAS

Figure V-A-4

(From Ref.1, Vol. 1, Fig. A-5)


SACRAMENTO
SONOMA
NAPA
SOLANO
MARIN
SAN PABLO BAY
CONTRA COSTA
PACIFIC OCEAN
Gulf of the Farallones
FARALLON ISLANDS
SAN FRANCISCO
SAN FRANCISCO BAY
SAN MATEO
SANTA CLARA
ALAMEDA
San Jose
San Rafael
Livermore
Santa Cruz
Watsonville
San Leandro
Palo Alto
Dumbarton Toll Bridge
S.P.R.R. Bridge
F.A. 6,500
F.A. 3,500
F.A. 12,000
F.A. 1,500
F.A. 5,000
F.A. 7,500
F.A. 6,000
F.A. 2,500
F.A. 7,000
SCALE IN MILES

2

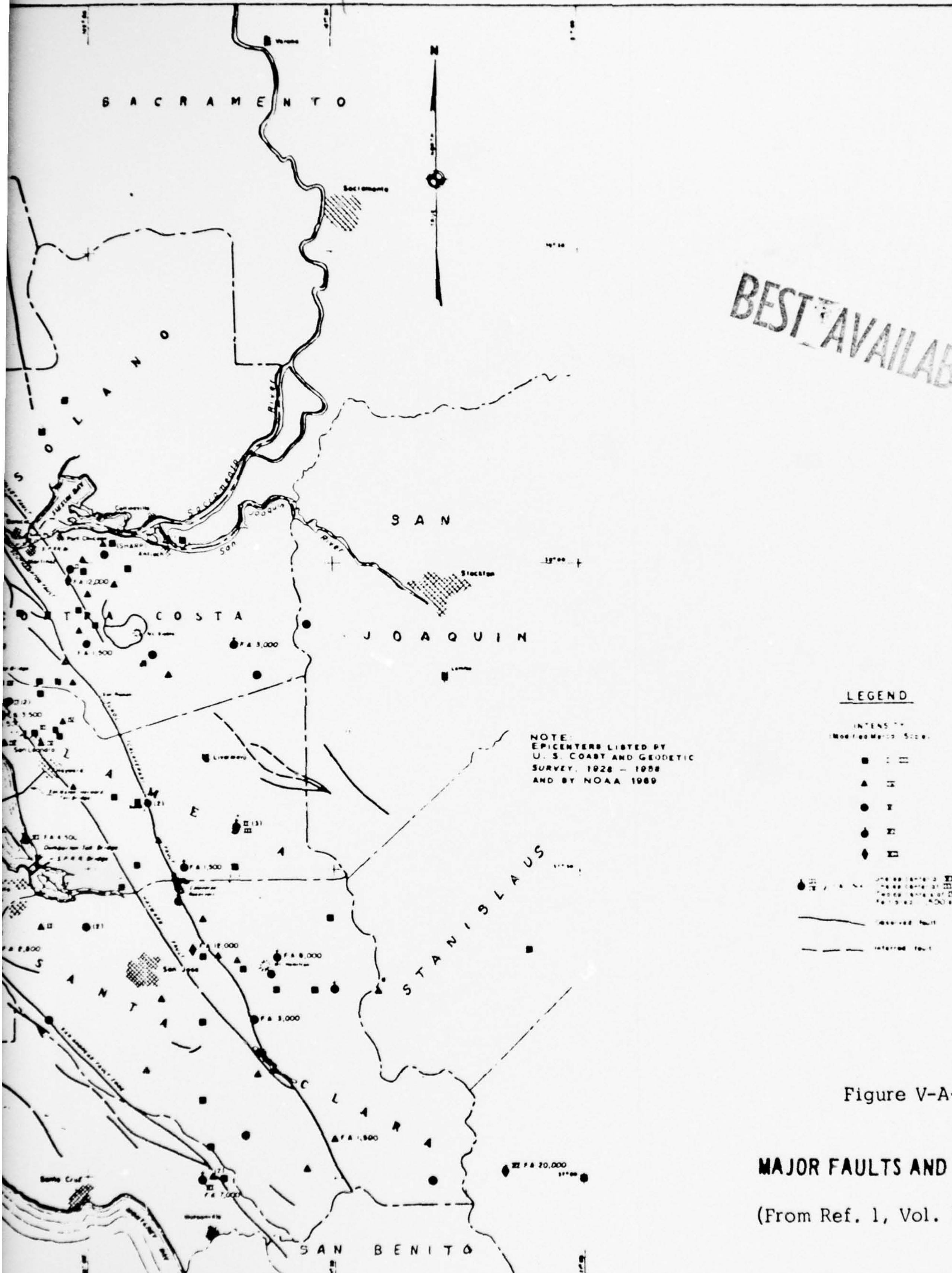


Figure V-A-5

MAJOR FAULTS AND EPICENTERS

(From Ref. 1, Vol. 1, Fig. A-6)

Francisco Bay depression which divides the Coast Ranges into a north and central sections. The San Francisco Bay depression and the intermountain valleys are gently sloping to nearly flat flood-plains and low terraces with gently rolling alluvial fans and older terrace remnants lying adjacent to the upland areas.

"The Great Valley consists of a central, comparatively flat alluvial plain, about 400 miles long and 50 miles wide, lying between the Coast Ranges on the west and the Sierra Nevada range on the east. Elevations in the Great Valley, with few exceptions, range from sea level to 100 feet" (Ref. 1.) The Central Valley includes three physiographic regions; (1) the Sacramento Valley to the north, (2) the San Joaquin Valley to the south including the Tulare Lake closed basin in the southern end, and (3) the Delta, a unique geomorphic region encompassing about 1150 square miles at the confluence of the Sacramento and Joaquin Rivers interlaced with about 700 miles of meandering waterways.

The Sierra Nevada consists of broad foothills and rugged mountains ranging to over 10,000 feet; it is composed of a high fault block of granitic and metamorphic rock formations which are overlain with remnants of Tertiary (1 to 60 million year old) volcanic and sedimentary rocks. The block tilts in a gentle downward slope to the west which dips beneath the sediments of the Central Valley. Deep canyons cut by river action at right angles to the trend of the the mountains are characteristic along the western slopes.

"The rocks of the Coast Range are predominantly consolidated marine sedimentary and volcanic rocks. Unconsolidated marine sediments and alluvial deposits are also present in the valley floor and in San Francisco Bay. Consolidated rocks in the Great Valley province are also present, but lie at depths below thick accumulations of unconsolidated alluvial deposits. Common to all of the alternative wastewater management systems are the active San Andreas Fault System and the weak, compressible, unconsolidated sediments of the San Francisco Bay and Delta area" (Ref. 1.)

c. Terrestrial Ecology and Soils

The Study Region includes several of the major terrestrial communities or biomes of the North American continent; the Northern Coniferous or Evergreen forests (tiaga), the Moist Coniferous forests, Temperate grasslands, and Chaparral (Ref. 3.) The Study Region is also located completely within one of the great soil group regions of North America, that of the complex soils of mountains and mountain valleys (Refs. 3,4.) This region is associated with areas which are geologically young, where the controls of climate and vegetation have not had the time to develop a uniform soil cover

over a large region. It includes elements of other regionally uniform or zonal types of soils together with the geologically young azonal soils, the variations depending upon climate, vegetation, elevation, and latitude.

Northern Coniferous Forests stretch in a broad belt all the way across Canada and in somewhat narrow belts down from western Canada along the eastern half of the Pacific Coast mountain system and all along the Sierra Nevada. The identifying life forms are the needle-leaved evergreen trees, such as the spruces, firs, and pines. The associated dense shade often produces a poorly developed understory or shrub and herb layer. Since coniferous needles decay rather slowly, associated soils tend to develop the characteristic podzol profile, particularly with cool, humid climates. Podzol soils, common in mountainous areas, especially in coniferous regions, are rarely more than two feet in depth. The humified, humifying, and leaching surface or "A" horizon (the topsoil) of the soil profile consists typically of a top humus layer, which is acidic and thin, and a lower pale, washed-out looking, white or ash-grey zone which is highly leached of elements such as iron and aluminum. The mineralized subsurface or "B" horizon (the subsoil) typically is a clayey, brown zone formed by the accumulation of deposited elements such as iron and aluminum. In the Study Region, these types of forest habitats are primarily confined to the western slopes of the Sierra Nevada and generally between the elevations of 1,200 to 10,000 feet (Refs. 3,5.) Some of the more noted of the dominant trees are the Ponderosa or yellow pine at the lower elevations or transition zone and the red fir and lodgepole pine at the higher elevations or Canadian zone.

Moist coniferous forests occur all along the western part of the Pacific Coast mountain system from Alaska to central California, wherever the temperatures are higher than that occuring in Northern Coniferous forest areas, the seasonal range relatively small, and the humidity very high. Fog compensates for high precipitation in the southern areas and particularly in the San Francisco Bay area. The identifying life form is still the needle-leaved evergreen tree. In the Study Region, the most distinctive species is the redwood (Sequoia sempervirens.) These forests are distinguished from the Northern Coniferous by a well developed understory wherever any light filters through together with an abundance of mosses and other moisture-living lesser plants. The tendency toward podzol soil formation is to be expected because of the associated higher precipitation and moisture levels.

Temperate grasslands in the Study Region are confined primarily to the great flatlands of the Central Valley. They occur naturally where rainfall is too low to support forest habitats but higher than that associated with desert habitats. These grasslands are typically associated with chernozemic

soils. The chernozems themselves are associated with more humid climatic conditions. Their topsoils contain much more organic matter and therefore are much darker and deeper, usually several feet. Their subsoils contain concentrations of calcium carbonate or lime produced from the decay and subsequent leaching of dead grass. Prairie soils are associated with intermediate rainfall levels. Topsoils are brown-black and, with less leaching, have high mineral and organic content. The topsoil and subsoil varies in depth from 2.5 to 6 feet typically. Chesnut and brown soils are associated with steppe or semi-arid climatic conditions. Their topsoils are thinner. Lower humus and less precipitation produce the chesnut and brown color. A lime accumulation layer typically is within a foot or two of the surface.

Chaparral habitats occur in the Study Region generally along the eastern part of the Coast Range north of the Golden Gate, throughout the Coast Range south of the Golden Gate, and all along the foothills and valley margins of the Sierra Nevada in what is referred to as the Upper Sonoran Life Zone (500 to 1,500 feet elevation) (Refs. 3,5.) These habitats are associated with an abundance of winter rainfall together with dry summers. The identifying life forms of the chaparral proper or coastal chaparral are shrubs with hard, thick evergreen leaves. In the Study Region, chamis (*Adenostoma*) and manzanita (*Arctostaphylos*) are typical common shrubs which often form dense thickets. A number of evergreen oaks are also characteristic as either shrubs or trees. Chaparral habitats also include "broad-sclerophyll woodlands" where scattered trees are the identifying life forms. "Smooth grass and sparse, rounded clusters of trees give the woodland a groomed, parklike appearance" (Ref. 5.) Live oaks are common together with occasionally intermingling California sycamores and the distinctive digger pine. The non-native trees of the Eucalyptus genus are also found in chaparral regions in the Study Region. Chaparral habitats are considered intermediate between grasslands and northern coniferous forests. Chaparral habitats are frequently associated with chesnut and brown soils which have been briefly described in the previous paragraph.

Plant communities are regional elements of vegetation which are characterized by recurrent or distinctive assemblages of certain dominant plant species or distinctive plant types. Both climatic and edaphic (soil and other "local") conditions affect the distribution of plants and, in the process, regulate plant communities. The processes are complex and the various plant community or habitat classification schemes are many. Table V-A-1 presents a superficial comparison of three different vegetative cover, habitat, and community classification schema together with some indicator plant species for some of the categories. It should be pointed out that technically speaking plant communities and habitat types are not synonymous.

Table V-A-1

VEGETATIVE COVER TYPES, CALIFORNIA HABITAT TYPES AND PLANT COMMUNITIES AND SOME ASSOCIATED INDICATOR PLANT SPECIES

USSCS Megetative Cover Types 1/	Calif. Fish & Wildlife Plan Habitat Types 2/	Munz & Keck's Plant Communities 3/
Coniferous Forest	Redwood Forest Coast Redwood, Douglas fir, California laurel (bay) tan-bark oak, madrone, Rhododendron	Redwood Forest Coast Redwood, Douglas fir tan-bark oak, Rhododendron wax myrtle
	Coastal forest Douglas fir, redwood California laurel, tan-bark oak, madrone	Douglas fir forest
	Pine-fir-chaparral	Yellow pine forest
	Minor conifers	Closed-cone pine forest Monterey pine, Bishop pine, beach pine, Monterey cypres
Hardwoods	Hardwood Live oak, black oak	Mixed evergreen forest
	Woodland-chaparral	
	Woodland-sagebrush	Foothill woodland
	Woodland-grasses Oaks, broadleaf trees, grasses	Northern oak woodland
Grass-Forbs	Grasslands Filaree, fescue, cheat grass, brome, soft chess	Valley grassland Annual grass species of Bromus, Fetuca, Avena, Stipa
		Coastal prairie
Chaparral-Mt. Brush	Chaparral Chamise, manzanita, Ceanothus	Chaparral Chamise, toyon, coffee-berry, California lilac, manzanita
		Northern coastal scrub
		Coastal strand
	Coast sagebrush	Coastal sage scrub
Southern Desert Shrub	Saltbrush-buckwheat	
Pinyon-Juniper	Juniper-Pinyon pine	Pinyon juniper woodland
Marsh	Marsh	Coastal salt marsh
	Seasonal marsh	Freshwater marsh
Water	Lakes, bays, reservoirs	------
Agriculture	Agriculture	
Urban	Urban industrial	
Barren	Barren	

Note: designations on same line readily comparable; overlapping designations indicated by a line between different designations

1. from U.S. Soil Conservation Service vegetative cover maps
2. from Ref. 32, Part A
3. from Ref. 75

Up to this point, the soil designations used have been very general. Table V-A-2 gives a few of the methods and terms used to classify soils for the selected land application study sites. Table V-A-3 gives a description of the more detailed soil associations designations occuring in the nine selected land application study sites studied in the previous Volume II of the Study Project. A complete species list for all potential wastewater application areas is found in the Appendix (Chapter K.)

d. Climatology and Meteorology

The wastewater sites are located in climatic regimes ranging from semi-arid to coastal. Annual precipitation varies from about 10 inches in portions of Sites 42 and 43 to almost 60 inches in portions of Site 21. Approximately 80 percent of the total annual precipitation occurs in the five-month period of November through March in each site. Table V-A-4 gives precipitation and vegetative requirement data for the site sub-areas. Snowfall is rare in any of the sites and is usually confined to elevations above 1,000 feet. Frosts in late Spring are a hazard to vegetation in some areas. Crops in these areas are protected from frost by sprinklers, wind machines and smudge pots. Prevailing winds in the sites are generally from the east-southeasterly to south-southeasterly directions at an average velocity of 2 to 10 miles per hour. Maximum wind velocities in the sites generally occur during the month of July.

Air quality in the sites is affected by fluctuations in pollutant emissions and by weather patterns. If emissions remained constant from year to year, the pollution levels would still fluctuate widely with random variations in inversion base, temperature, sunshine and wind. Weather factors determine the amount of air available to dilute the contaminants and are generally beyond the control of present technology.

Oxidants is the term used to describe the photochemical pollutants produced from a chemical reaction which takes place in the atmosphere between NO_2 and organic compounds under the influence of sunshine. Various factors, including the quantities of gases present, the volume of air available for dilution, the temperature and the amount of sunshine affect this process. The major effects of the presence of oxidants are visibility reduction, vegetation damage and eye irritation. The largest fraction of oxidants is Ozone; other substances include nitrogen dioxide and peroxyacetylnitrate (PAN). The most frequent periods of high oxidants occur during the months of July through November, and otherwise on warm, sunny, windless days (Ref. 142.)

Oxidant data from a full decade of continuous monitoring in the Bay Area indicates a trend of decreasing oxidant levels. Although some

Table V-A-2

SOIL AND SUB-SOIL CLASSIFICATION METHODS

Parameter	Descriptive Terms
Texture (very general)	Light, medium, heavy, etc.
Particle Size Distribution	Sandy loam, silty clay, etc.
Association (identifies characteristic by location)	Yolo-Brentwood, Marvin-Rincon, etc.
Surface Runoff Potential 1/	Group A, B, C, etc.
Capability (for stated 1/ use such as agriculture)	Class I, II, III, etc.
Geologic Location	Marine Terrace, Alluvial Fan, etc.

(From Vol. II, Table II-C-1, Pg. C-7)

NOTES:

1/ From Refs. 10a - 10j.

Table V-A-3

SOIL ASSOCIATION PARAMETERS

(From Vol. II, Table II-C-2, Pg. C-9)

Soil Association	General Position 1/	SOIL DESCRIPTIONS: Surface Layer 2/	SOIL DESCRIPTIONS: Subsoil 3/	Erosion Hazard	Effective Depth (Inches) 4/	AWC (Inches) 5/	Estimated Soil Application Limitation (ft/yr) 7/
		CAPABILITY CLASS I 6/					
Brentwood-Yolo	AF, FP	Silty clay loam	Silty clay loam	none	60+	8-11	90
Brentwood-Yolo-Sycamore	AF	Massive, blocky clay loam	Massive silty loam	none	60+	8-11	90
Columbia-Sycamore	AF	Massive sandy & silty loam	Massive fine sandy & silty loam	none	60+	6-10	90
Sorrento	AF	Granular silty clay loam	Blocky silty clay loam	none	60	>7.5	45
Lost Hills	AF	Granular clay loam	Blocky clay loam	slight	36-60+	5-10	25
Panoche	AF	Granular loam	Blocky loam	slight	60+	7.5-10	45
San Emigdio	AF	Granular sandy loam	Massive sandy loam	slight	60+	7.5-9	90
Yolo (Overflow)-Zamora	AF, FP	Massive, blocky loam & silty clay loam	Massive fine sandy laom	slight	60+	8-11	90
Chualar	AF	Blocky sandy loam	Blocky clay loam	slight	60+	8-10	90
Salinas-Mocho	AF	Blocky clay loam & silty clay loam	Massive & blocky silty clay loam	none to slight	60+	8-11	45
Brentwood-Zamora-Sorrento-Los Robles	AF, VT	Granular or blocky clay loam	Heavy blocky or light silty clay loam	none	60+	10-12	45
Cropley-Rincon	VF, AF	Blocky clay loam	Blocky clay	none	60+	8-10	45
		CAPABILITY CLASS II 6/					
Marvin-Rincon-(Tehama)	AF	Silty loam & silty clay loam	Dense clay loam or silty clay	none to slight	*	*	45
Capay-Clear Lake	BR	Silty clay	Silty clay	none	*	*	40
Capay-Clear Lake-Sacramento	BR, AF	Silty loam & silty clay loam	Clay	none to slight	*	*	30
Harrington	AF	Massive silty clay loam	Blocky clay	slight	60+	8-10	45
Columbia-Lang	AF	Massive fine sandy loam	Massive or mottled sandy loam	none to slight	60	3-9	90
Valdez-Merritt	AF	Massive or granular silty clay loam	Mottled silty clay loam	none	36-60	6-10	45
Lost Hills	AF	Granular clay loam	Blocky clay	slight	60	5-7.5	25
Pleasanton-Esparto	AF	Massive gravelly sandy loam	Massive & blocky sandy clay loam	slight	60	5-7.5	90
Merced-Temple	B	Blocky or granular silty clay	Blocky or silty clay	slight	36-60	6-9	25
Pajaro	AF	Fine sandy laom	Massive clay	slight	30-50	5-6.5	20
Clear Lake	B, FP	Massive clay	Massive clay	none to slight	52-60	8.75-10	15
Pleasanton-Zamora	AF, FP	Massive gravelly loam or silty clay loam	Massive gravelly clay or silty clay loam	slight	60+	9-11	45
Yolo-Cortina-Pleasanton	AF	Massive gravelly sandy loam	Massive loam or gravelly sand	slight	60+	3-10	90
Farrallone	AF	Gravelly sandy loam	Blocky sandy loam	slight	60+	5-7.5	90
Cropley	AF	Weak granular clay	Silty clay	none	60+	10-12	45
Clear Lake-Pacheco	B, AF	Blocky clay or clay loam	Massive clay or loam	none to slight	36-60+	6-11	45
Tunitas-Lockwood	VT	Blocky loam or granular clay loam	Clay or massive shaly clay loam	none to slight	60+	10+	30
Valdez-Columbia	AF	Silty or sandy loam	Mottled sandy loam	*	*	*	90
		CAPABILITY CLASS III 6/					
Valdez	FP	Mottled silty clay loam	Mottled silt	none	60+	4-6	45
Arbuckle-Cortina	AF	Massive gravelly or sandy loam	Massive gravelly clay or sandy loam	slight	10-36	1-6	45
Sacramento-Willows	BR	Blocky clay	Mottled clay	none	60+	8-10	15
Columbia-Sandy Alluvial	AF, FP	Massive or single-grain sandy loam	Mottled sandy loam and coarse sand	removal and deposition	60+	4+	90
Stockton-Sacramento	B, BR	Blocky, mottled clay	Massive, mottled clay	slight	30-60+	5-10+	15
Sycamore-Colusa	AF, BR	Silty clay loam	Massive, mottled silty clay loam	slight	60+	5-10+	45
[illegible]	[illegible]	Blocky silty clay loam	Blocky clay	slight	40-60+	8-10+	45

2

Clear Lake-Pacheco	B,AF	Blocky clay or clay loam	Massive clay or loam				
Tunitas-Lockwood	VT	Blocky loam or granular clay loam	Clay or massive shaly clay loam	none to slight	60+	10+	30
Valdez-Columbia	AF	Silty or sandy loam	Mottled sandy loam	*	*	*	90
		CAPABILITY CLASS III 6/					
Valdez	FP	Mottled silty clay loam	Mottled silt	none	60+	4-6	45
Arbuckle-Cortina	AF	Massive gravelly or sandy loam	Massive gravelly clay or sandy loam	slight	10-36	1-6	45
Sacramento-Willows	BR	Blocky clay	Mottled clay	none	60+	8-10	15
Columbia-Sandy Alluvial	AF, FP	Massive or single-grain sandy loam	Mottled sandy loam and coarse sand	removal and deposition	60+	4+	90
Stockton-Sacramento	B, BR	Blocky, mottled clay	Massive, mottled clay	slight	30-60+	5-10+	15
Sycamore-Colusa	AF, BR	Silty clay loam	Massive, mottled silty clay loam	slight	60+	5-10+	45
Landlow-Marvin	BR	Blocky silty clay loam	Blocky clay	slight	40-60+	8-10+	45
Oxalis	B	Hard blocky clay	Hard blocky silty clay	slight	20-36	3-5	15
Merced-Temple	B	Blocky or silty clay	Blocky clay or silty clay	slight	30-60+	6-9	25
Cotati	UT	Massive fine sandy loam	Coarse clay	mod.	24-36	4.2-5.8	30
Huichica-Wright	VT, FP	Massive loam	Coarse mottled clay	slight	20-36	3-10	30
Antioch-Gloria	ST	Massive blocky loam	Clay	high	9-24	2-6	15
Chualar	AF, VT	Granular or blocky sandy loam	Blocky clay loam	slight	60+	8-10	90
Placentia	UT	Massive sandy loam	Clay	slight	18-30	2-4	15
Elkhorn	MT	Blocky sandy loam	Massive sandy clay loam	slight to mod.	40-60	6.5-7.5	45
Watsonville-Elkhorn	VT	Granular loam or sandy loam	Blocky clay or sandy clay loam	mod.	25-30	2-4	45
Sacramento	B	Clay	Mottled blocky clay	none	to water table	5-10	20
Staten-Egbert	FP	Mucky clay loam	Clay loam & fibrous peaty material	mod.	to water table	3-7	15
Perkins-Kimball	VT	Massive clay loam	Blocky clay	mod.	20-60	4-9	15
Ryde-Egbert	AF	Silty clay loam	Mottled mucky clay loam	mod. to high (wind)	60+	7.5+	15
Staten-Venice	FP	Muck	Peaty muck	high (wind)	60+	7.5+	15
Dinuba	AF	Sandy loam	Mottled sandy loam	none	32-48	4-6	30
Stockton-Landlow	B, BR	Clay	Clay	None	30-54	5-7	15
		CAPABILITY CLASS IV 6/					
Corning-Hillgate	UT	Gravelly loam	Gravelly clay	mod.	*	*	20
Pescadero-Willows	BR	Mottled & silty clay	Mottled & silty clay	none	*	*	15
Sehorn-Balcolm	B	Clay	Clay	slight	*	*	10
Ayar-Rumsey	RU	Granular clay	Blocky clay	mod.	20-36	3-6	5
Sycamore-Tyndall	FP	Silty clay loam & sandy loam	Silty clay loam & sandy loam	none	*	*	45
San Joaquin-Alamo	UT	Massive loam & coarse blocky clay	Blocky mottled clay	none to slight	12-36	2-6	10
Los Banos	VF	Blocky clay loam	Clay	slight to mod.	60	>5.7	5
Positas	AF	Massive gravelly fine sandy loam	Gravelly clay	slight	20-36	3-5	5
Lethent	AF	Blocky cilty clay loam	Blocky silty clay	none	60	5-7.5	15
Goldridge	MT	Massive fine sandy loam	Massive sandy clay	mod.	41-57	5-7.5	20
Rohnerville-Kneeland	MT, SU	Granular loam	Massive sandy clay or fine clay loam	slight	18-40	3.5-6.5	10
Reyes	TF	Fine granular silty clay	Coarse silty clay	slight	31-51	5.6-6.2	10
Metz-Riverwash	FP	Loose silts & sands	Loose stratified sands	high	variable to 60+	1-5	45
Tierra-Colma	ST	Granular sandy loam	Blocky loam & clay loam	mod.	30-60+	2-4	10
Altamont-San Benito-Linne	RU	Clay or silty clay loam	Blocky clay & silty clay loam	mod.	20-60	4-8	15
Solano-San Ysidro	VT, BR	Massive loam	Silty or blocky clay	slight to mod.	10-24	<4	10
Linne-Altamont	RU	Clay & granular clay loam	Mottled clay & blocky clay loam	mod.	20-60	4-8	15
Diablo-Altamont	RU	Clay	Blocky clay	mod.	36-60	5-8	5
Pescadero	BR	Clay	Blocky clay	slight	20-36	5-7	5
		CAPABILITY CLASS V 6/ CAPABILITY CLASS VI 6/					
Reyes-Tamba	TF	Mottled clay & muck	Mottled clay & muck	none	20-36	4-6	5
Suisun-Joice	TF	Peaty muck & clay	Peaty muck & clay	none	varies with water table	6-10	5
Dibble-Millsholm	SU	Clay loam & rocky loam	Clay & stony loam	mod. to high	*	*	5
Altamont-Rumsey	RU	Granular clay loam	Blocky hard clay	mod.	20-36	3-6	5
Alluvial Land-Riverwash	AF	Poorly mixed sand and alluvium ranging from sandy loam		*	*	*	90
Goldridge	MT, ST	Massive fine sandy loam	Hard massive sandy clay	mod.	41-57	5-7.5	30
Hugo-Laughlin-Josephine	SU	Gravelly loam	Massive loam, clay loam	slight to mod.	10-48	1.75-8	5
[illegible]	[illegible]	Massive loam & clay loam	Hard coarse & massive	slight to mod.	24-55	6-8	5

3'

Diablo-Altamont	RU	Clay	Blocky clay	mod.	36-60	5-8	5
Pescadero	BR	Clay	Blocky clay	slight	20-36	5-7	5
		CAPABILITY CLASS V 6/ CAPABILITY CLASS VI 6/					
Reyes-Tamba	TF	Mottled clay & muck	Mottled clay & muck	none	20-36	4-6	5
Suisun-Joice	TF	Peaty muck & clay	Peaty muck & clay	none	varies with water table	6-10	5
Dibble-Millsholm	SU	Clay loam & rocky loam	Clay & stony loam	mod. to high	*	*	5
Altamont-Rumsey	RU	Granular clay loam	Blocky hard clay	mod.	20-36	3-6	5
Alluvial Land-Riverwash	AF	Poorly mixed sand and alluvium ranging from sandy loam		*	*	*	90
Goldridge	MT,ST	Massive fine sandy loam	Hard massive sandy clay	mod.	41-57	5-7.5	30
Hugo-Laughlin-Josephine	SU	Gravelly loam	Massive loam, clay loam	slight to mod.	10-48	1.75-8	5
Steinbeck-Los Osos	MT,SU	Massive loam & clay loam	Hard coarse & massive clay	slight to mod.	24-55	6-8	5
Hugo-Josephine	RU,SU	Gravelly loam	Blocky loam & clay loam	slight to mod.	24-48	4.5-8	5
Los Osos	SU	Hard massive clay loam	Hard massive clay	mod.	20-28	4-6	5
Laughlin-Parrish	RU,SU	Grannular, blocky loam	Massive loam & clay loam	mod.	10-36	2-7.5	5
Goulding-Toomes	SU	Granular clay loam & hard rocky loam	Hard massive clay loam	slight to mod.	8-24	1-4.5	5
Antioch-Gloria	ST	Hard blocky loam	Very hard clay	high	8-24	2-6	5
McCoy	SU	Blocky hard clay loam	Blocky hard clay loam	mod.	36-48	5-8	5
Los Gatos-Cotati	SU	Hard granular clay loam	Blocky hard clay loam	high	20-60	4-8	5
Gloria-Placentia	ST	Hard massive loam & sandy loam	Very hard clay	high	8-30	1-4	5
Lobitos-Gazos	SU	Granular loam	Hard clay loam & granular silty loam	high	25-30	4-6	5
Tierra-Colma	ST	Granular sandy loam	Hard clay loam	high	30-60+	2-4	5
Arnold	RU	Loamy sand	Loamy sand	high	20-36	>4	30
Altamont-San Benito	SU	Clay & silty clay loam	Blocky clay & silty clay loam	mod.	20-60	4-8	10
		CAPABILITY CLASS VII 6/					
Positas	ST	Gravelly loam	Gravelly clay	very high	10-20	1-3	5
Dibble-Millsholm	SU	Clay & rocky loam	Clay & stony loam	mod. to high	*	*	5
Cibo	SU	Hard stony clay	Hard block clay	*	*	*	5
Kettleman	RU	Granular silty clay loam	Blockly silty clay loam	mod. to severe	10-48	2-5	5
Vallecitos	SU	Granular stony clay loam	Hard massive clay loam	mod.	15-25	3-5	5
Los Banos	ST	Hard massive clay loam	Hard blocky clay	mod. to high	20-30	2-3.5	5
Yorkville-Sutherlin	RU	Hard clay loam	Hard mottled & gravelly clay	mod. to high	20-45	5-6	10
Henneke	SU	Gravelly loam	Cobbly loam	*	*	*	10
Los Gatos-Maymen (Henneke)	RU,SU	Granular loam & massive sandy loam	Massive gravelly clay loam	mod. to high	10-40	1.5-6.5	10
Loamy Alluvial Land	AF	Sands, loams & coarse loams	Stratified gravel sands & loams	variable	60+	4-10	90
Jiggs-Kidd-Rock	SU	Gravelly & rocky sandy loams	Gravelly loam & sandy clay loam	slight	0-25	.05-5	20
Spreckels-Felta	SU	Blocky & gravelly loam	Hard massive clay & gravelly clay loam	slight to mod.	14-26	3-5.5	20
Sheridan	SU,M	Gravelly loam	Gravelly sandy loam	mod.	30-48	5-6	20
Sheridan	SU,M	Coarse sandy loam	Coarse sandy loam	high	15-30	3-5	20
Arnold	SU	Blocky loamy sand	Massive loamy sand	mod.	30-60	2-4	20
Vista	M	Granular sandy loam	Massive sandy loam	high	20-24	3-4	20
Hugo-Butano-Josephine	SU,M	Granular silty loam	Hard blocky sandy loam & clay loam	high	30-40	3-6	20
Arnold-San Andreas	SU	Sand & sandy loam	Sandy loam & loamy sand	high	36-60+	3-7	20
Lobitos-Gazos-Santa Lucia	SU,M	Granular shaly loam & silty loam	Hard granular loam & silty loam	mod. to high	25-30	4-6	5
Sweeney-Mindego	M,SU	Hard granular clay loam	Hard blocky clay & clay loam	high	30-40	4-6	5
Los Gatos-Gaviota-Sobrante	SU	Blocky sandy loam & granular clay loam	Massive loam, sandy loam & clay loam	high to very high	20-36	3-7	5
Los Osos-Millsholm-Gazos	SU	Blocky clay loam & silty loam	Clay, loam & blocky clay loam	high to very high	10-35	4-7	5
Los Gatos-Gaviota	SU	Blocky & sandy loam	Massive loam & sandy loam	high to very high	20-36	3-6	20
		CAPABILITY CLASS VIII 6/					
Rockland	SU	Loose stones & boulders lying on the surface and embedded in shallow soil material		very high	*	*	5
Rough Rockland	M	Coast range areas with slopes greater than 50% or more than 50% rock outcrops		*	*	*	5
Dune Land	MT	Stratified coarse loamy sand & fine sand		high (wind)	60+	2-3	30

Los Gatos-Gaviota-Sobrante	SU	Blocky sandy loam & granular clay loam	Massive loam, sandy loam & clay loam	high to very high			
Los Osos-Millsholm-Gazos	SU	Blocky clay loam & silty loam	Clay, loam & blocky clay loam	high to very high	10-35	4-7	5
Los Gatos-Gaviota	SU	Blocky & sandy loam	Massive loam & sandy loam	high to very high	20-36	3-6	20
		CAPABILITY CLASS VIII 6/					
Rockland	SU	Loose stones & boulders lying on the surface and embedded in shallow soil material		very high	*	*	5
Rough Rockland	M	Coast range areas with slopes greater than 50% or more than 50% rock outcrops		*	*	*	5
Dune Land	MT	Stratified coarse loamy sand & fine sand		high (wind)	60+	2-3	30
Tidal Flats	TF	Mixed plant remains. Bay mud and sediments		slight	20-36	4-6	10
Cieneba-Sheridan	M	Gravelly sandy loam	Gravelly sandy loam & weathered granite	very high	5-36	1-4	5
Maymen-Los Gatos	SU,M	Granular gravelly loam	Granular loam & gravelly clay loam	high	12-24	>3	5
Santa Lucia-Rockland	SU,M	Shaly loam & rock outcrop	Shaly clay loam & rock outcrop	high	10-24	1-3	5

NOTES:

1/

	Estimated Range of Slope for Proposed Use (%)
FP - Flood Plain	0-2
TF - Tidal Flats	0-2
AF - Alluvial Fan	0-2
VF - Valley Floor	0-5
B - Basin	0-5
BR - Basin Rim	0-10
MT - Marine Terrace	10-30
VT - Valley Terrace	0-10
UT - Undulating Terrace	10-20
ST - Steep Terrace	10-30
RU - Rolling Upland	10-30
SU - Steep Upland	20-30
M - Mountains	>30

2/ Typically about 5 to 8 inches in thickness (the ordinary plowed layer).

3/ The part of the profile below the surface layer.

4/ The depth to which a soil is readily penetrated by roots and utilized for extraction of water and plant nutrients.

5/ (Available water holding capacity); the portion of water within the effective depth of a soil that can be readily absorbed by plant roots.

6/ CAPABILITY CLASSES (Refs. 10a - 10j)

I: Very deep, well drained, medium to moderately fine textured, nearly level soils. These soils typically occupy valley bottoms and fans and are generally suitable as rapid infiltration areas.

II: Deep to very deep, moderately to well drained, moderately coarse to fine textured, nearly level soils. These soils typically occupy alluvial fans, flood plains and basins, and are generally suitable as rapid infiltration and cropped areas.

III: Moderately deep to very deep, poorly to well drained, fine to very coarse textured, nearly level to strongly sloping soils. These soils typically occupy flood plains, basins, and dissected terraces and are generally suitable as cropped and pasture areas.

IV: Shallow to very deep, poorly to well drained, loam and clay loam textured with some claypan subsoils, nearly level (flood basins) to moderately steeply sloping soils. These soils typically occur in basins (some outside present levee systems) and on terraces, and may be suitable as cropped areas but are generally utilized for pastures.

V: Not included in County Reports.

VI: Moderately deep, well drained, medium to fine textured, steeply sloping soils. These soils occur on steep terraces and uplands and may be suitable as pasture areas but are generally utilized for forests.

VII: Shallow to moderately deep, well drained and moderately eroded, gravelly to rocky textured with claypan, shale and sandstone substrate, steeply to very steeply sloping soils. These soils occur on steep to very steep uplands and are generally suitable for forests.

VIII: Very shallow, very coarse and eroded soils with frequent rock outcrops. These soils occupy steep rocky uplands, gullies, and stream channels, and are generally excluded.

7/ Estimated from the maximum application rates given in Figure ~~V-A-6~~ 6 and a four-day rotation schedule consisting of one day of loading and three days of soil resting.

* No data available.

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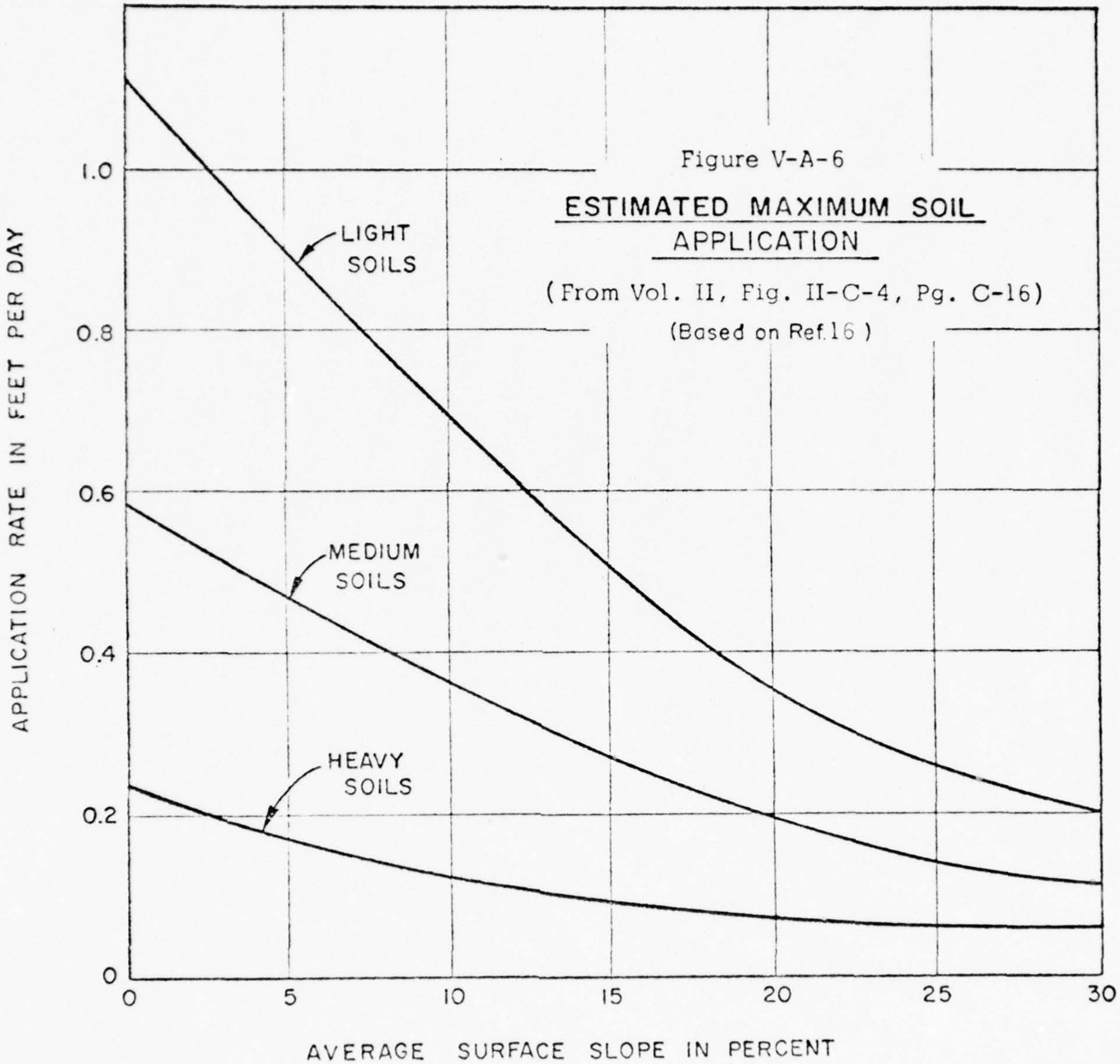

Figure V-A-6

ESTIMATED MAXIMUM SOIL APPLICATION

(From Vol. II, Fig. II-C-4, Pg. C-16)

(Based on Ref. 16)

Table V-A-4

MONTHLY AND ANNUAL WASTEWATER APPLICATION REQUIREMENTS
FOR OPTIMUM VEGETATIVE GROWTH
(inches)

Sub-Area (s)		January	February	March	April	May	June	July	August	September	October	November	December	Total
4.1	Pan Evap. 1/	1.3	1.3	2.6	4.6	7.8	10.4	11.7	10.4	7.2	4.6	2.0	1.3	65.2
	PET 2/	0.9	0.9	1.8	3.2	5.5	7.3	8.2	7.3	5.0	3.2	1.4	0.9	45.6
&	Precip. 3/	3.4	3.0	2.7	1.4	0.7	0.2	0.02	0.02	0.26	0.9	1.7	2.7	17.0
	Eff. Precip. 4/	2.7	2.4	2.2	1.1	0.6	0.2	0.02	0.02	0.2	0.7	1.4	2.2	13.7
4.2	Veg. Reqm't. 5/	-0-	-0-	-0-	2.1	4.9	7.1	8.2	7.3	4.8	2.5	-0-	-0-	36.9
	Site Reqm't. 6/	-0-	-0-	-0-	3.0	7.0	10.1	11.7	10.4	6.9	3.6	-0-	-0-	52.7
5.1	Pan Evap.	1.2	2.4	3.6	4.8	7.2	9.6	12.0	9.6	8.4	4.8	2.4	1.2	67.2
	PET	0.8	1.7	2.5	3.4	5.0	6.7	8.4	6.7	5.9	3.4	1.7	0.8	47.0
	Precip.	4.1	3.5	3.1	1.8	1.3	0.4	0.1	0.1	0.4	1.3	2.4	3.5	22.0
	Eff. Precip.	3.3	2.8	2.4	1.5	1.0	0.3	0.1	-0-	0.3	1.0	1.9	2.8	17.4
	Veg. Reqm't.	-0-	-0-	0.1	1.9	4.0	6.4	8.3	6.7	5.6	2.4	-0-	-0-	35.4
	Site Reqm't.	-0-	-0-	0.1	2.7	5.7	9.2	11.9	9.6	8.0	3.4	-0-	-0-	50.6
5.2	Pan Evap.	1.2	1.8	2.9	4.7	6.5	8.2	10.0	8.8	7.0	4.1	2.4	1.2	58.8
	PET	0.8	1.3	2.0	3.3	4.6	5.7	7.0	6.2	4.9	2.9	1.7	0.8	41.1
	Precip.	3.1	2.9	2.5	1.4	1.1	0.4	0.1	0.1	0.4	1.1	2.0	2.9	18.0
	Eff. Precip.	2.5	2.3	2.0	1.1	0.9	0.3	0.1	0.1	0.3	0.9	1.6	2.3	14.4
	Veg. Reqm't.	-0-	-0-	-0-	2.2	3.7	5.4	6.9	6.1	4.6	2.0	0.1	-0-	31.0
	Site Reqm't.	-0-	-0-	-0-	3.1	5.3	7.7	9.9	8.7	6.6	2.9	0.1	-0-	44.3
5.3	Pan Evap.	1.3	1.9	3.2	5.1	7.0	8.9	10.8	9.5	7.6	4.5	2.5	1.3	63.6
	PET	0.9	1.3	2.2	3.6	4.9	6.2	7.6	6.7	5.3	3.2	1.8	0.9	44.6
	Precip.	3.1	2.9	2.5	1.4	1.1	0.4	0.1	0.1	0.4	1.1	2.0	2.9	18.0
	Eff. Precip.	2.5	2.3	2.0	1.1	0.9	0.3	0.1	0.1	0.3	0.9	1.6	2.3	14.4
	Veg. Reqm't.	-0-	-0-	0.2	2.5	4.0	5.9	7.5	6.6	5.0	2.3	0.2	-0-	34.2
	Site Reqm't.	-0-	-0-	0.3	3.6	5.7	8.4	10.7	9.4	7.1	3.3	0.3	-0-	48.8
5.4	Pan Evap.	1.4	2.1	3.5	5.6	7.7	9.8	12.0	10.5	8.4	4.9	2.8	1.4	69.9
	PET	1.0	1.5	2.5	3.9	5.4	6.9	8.4	7.3	5.9	3.4	2.0	1.0	49.2
	Precip.	2.9	2.5	2.2	1.3	1.0	0.3	0.1	0.1	0.3	1.0	1.8	2.5	16.0
	Eff. Precip.	2.3	2.0	1.8	1.0	0.8	0.2	0.1	0.1	0.2	0.8	1.4	2.0	12.7
	Veg. Reqm't.	-0-	-0-	0.7	2.9	4.6	6.7	8.3	7.2	5.7	2.6	0.6	-0-	39.3
	Site Reqm't.	-0-	-0-	1.0	4.1	6.6	9.6	11.9	10.3	8.1	3.7	0.9	-0-	56.2
5.5	Pan Evap.	1.4	2.1	3.5	5.6	7.7	9.8	12.0	10.5	8.4	4.9	2.8	1.4	69.9
	PET	1.0	1.5	2.5	3.9	5.4	6.9	8.4	7.3	5.9	3.4	2.0	1.0	49.2
	Precip.	2.9	2.5	2.2	1.3	1.0	0.3	0.1	0.1	0.3	1.0	1.8	2.5	16.0
	Eff. Precip.	2.3	2.0	1.8	1.0	0.8	0.2	0.1	0.1	0.2	0.8	1.4	2.0	12.7
	Veg. Reqm't.	-0-	-0-	0.7	2.9	4.6	6.7	8.3	7.2	5.7	2.6	0.6	-0-	39.3
	Site Reqm't.	-0-	-0-	1.0	4.1	6.6	9.6	11.9	10.3	8.1	3.7	0.9	-0-	56.2
5.6	Pan Evap.	1.4	2.1	3.5	5.6	7.7	9.8	12.0	10.5	8.4	4.9	2.8	1.4	69.9
	PET	1.0	1.5	2.5	3.9	5.4	6.9	8.4	7.3	5.9	3.4	2.0	1.0	49.2
	Precip.	3.1	2.7	2.4	1.4	1.0	0.3	0.1	0.1	0.3	1.0	1.9	2.7	17.0
	Eff. Precip.	2.5	2.2	1.9	1.1	0.8	0.2	0.1	0.1	0.2	0.8	1.5	2.2	13.6
	Veg. Reqm't.	-0-	-0-	0.6	2.8	4.6	6.7	8.3	7.2	5.7	2.6	0.5	-0-	39.0
	Site Reqm't.	-0-	-0-	0.9	4.0	6.6	9.6	11.9	10.3	8.2	3.7	0.7	-0-	55.9
12.1	Pan Evap.	1.5	1.5	3.0	5.3	9.1	12.1	13.6	12.1	8.3	5.3	2.3	1.5	75.6
	PET	1.1	1.1	2.1	3.7	6.4	8.5	9.5	8.5	5.8	3.7	1.6	1.0	53.0
	Precip.	2.1	2.0	1.8	1.0	0.4	0.1	-0-	-0-	0.1	0.6	1.1	1.8	11.0
	Eff. Precip.	1.7	1.6	1.4	0.8	0.3	0.1	-0-	-0-	0.1	0.5	0.9	1.4	8.8
	Veg. Reqm't.	-0-	-0-	0.7	2.9	6.1	8.4	9.5	8.5	5.7	3.2	0.7	-0-	45.7
	Site Reqm't.	-0-	-0-	1.0	4.1	8.7	12.0	13.6	12.1	8.1	4.6	1.0	-0-	65.2
	Pan Evap.	1.5	1.5	3.0	5.3	9.1	12.1	13.6	12.1	8.3	5.3	2.3	1.5	75.6
	[illegible]	1.1	1.0	2.1	3.7	6.4	8.5	9.5	8.5	5.8	3.7	1.6	1.1	53.0

5.6	Pan Evap.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	PET	1.0	1.5	2.5	3.9	5.4	6.9	8.4	7.3	5.9	3.4	2.0	1.0	49.2
	Precip.	3.1	2.7	2.4	1.4	1.0	0.3	0.1	0.1	0.3	1.0	1.9	2.7	17.0
	Eff. Precip.	2.5	2.2	1.9	1.1	0.8	0.2	0.1	0.1	0.2	0.8	1.5	2.2	13.6
	Veg. Reqm't.	-0-	-0-	0.6	2.8	4.6	6.7	8.3	7.2	5.7	2.6	0.5	-0-	39.0
	Site Reqm't.	-0-	-0-	0.9	4.0	6.6	9.6	11.9	10.3	8.2	3.7	0.7	-0-	55.9
12.1	Pan Evap.	1.5	1.5	3.0	5.3	9.1	12.1	13.6	12.1	8.3	5.3	2.3	1.5	75.6
	PET	1.1	1.1	2.1	3.7	6.4	8.5	9.5	8.5	5.8	3.7	1.6	1.0	53.0
	Precip.	2.1	2.0	1.8	1.0	0.4	0.1	-0-	-0-	0.1	0.6	1.1	1.8	11.0
	Eff. Precip.	1.7	1.6	1.4	0.8	0.3	0.1	-0-	-0-	0.1	0.5	0.9	1.4	8.8
	Veg. Reqm't.	-0-	-0-	0.7	2.9	6.1	8.4	9.5	8.5	5.7	3.2	0.7	-0-	45.7
	Site Reqm't.	-0-	-0-	1.0	4.1	8.7	12.0	13.6	12.1	8.1	4.6	1.0	-0-	65.2
12.2	Pan Evap.	1.5	1.5	3.0	5.3	9.1	12.1	13.6	12.1	8.3	5.3	2.3	1.5	75.6
	PET	1.1	1.0	2.1	3.7	6.4	8.5	9.5	8.5	5.8	3.7	1.6	1.1	53.0
	Precip.	1.6	1.4	1.3	0.7	0.3	0.1	-0-	-0-	0.1	0.4	0.8	1.3	8.0
	Eff. Precip.	1.3	1.1	1.0	0.6	0.2	0.1	-0-	-0-	0.1	0.3	0.6	1.0	6.3
	Veg. Reqm't.	-0-	-0-	1.1	3.1	6.2	8.4	9.5	8.5	5.7	3.4	1.0	0.1	47.0
	Site Reqm't.	-0-	-0-	1.6	4.4	8.9	12.0	13.6	12.1	8.1	4.9	1.4	0.1	67.1
18.1, .4, .5	Pan Evap.	1.7	2.3	3.5	5.2	6.9	8.0	8.6	7.5	5.8	4.0	2.3	1.7	57.6
	PET	1.2	1.6	2.5	3.6	4.8	5.6	6.0	5.3	4.1	2.8	1.6	1.2	40.3
	Precip.	7.1	6.1	4.8	2.4	1.4	0.3	-0-	-0-	0.3	1.7	3.4	6.5	34.0
	Eff. Precip.	5.7	4.9	3.8	1.9	1.1	0.2	-0-	-0-	0.2	1.4	2.7	5.2	27.1
	Veg. Reqm't.	-0-	-0-	-0-	1.7	3.7	5.4	6.0	5.3	3.9	1.4	-0-	-0-	27.4
	Site Reqm't.	-0-	-0-	-0-	2.4	5.3	7.7	8.6	7.6	5.6	2.0	-0-	-0-	39.2
18.2, .4, .5	Pan Evap.	1.7	2.3	3.5	5.2	6.9	8.0	8.6	7.5	5.8	4.0	2.3	1.7	57.6
	PET	1.2	1.6	2.5	3.6	4.8	5.6	6.0	5.3	4.1	2.8	1.6	1.2	40.3
	Precip.	9.2	7.9	6.2	3.1	1.8	0.4	-0-	-0-	0.4	2.2	4.4	8.4	44.0
	Eff. Precip.	7.4	6.3	5.0	2.5	1.4	0.3	-0-	-0-	0.3	1.8	3.5	6.7	35.2
	Veg. Reqm't.	-0-	-0-	-0-	1.1	3.4	5.3	6.0	5.3	3.8	1.0	-0-	-0-	25.9
	Site Reqm't.	-0-	-0-	-0-	1.6	4.9	7.6	8.6	7.6	5.4	1.4	-0-	-0-	37.1
18.3, .6	Pan Evap.	1.7	2.3	3.5	5.2	6.9	8.0	8.6	7.5	5.8	4.0	2.3	1.7	57.6
	PET	1.2	1.6	2.5	3.6	4.8	5.6	6.0	5.3	4.1	2.8	1.6	1.2	40.3
	Precip.	7.4	6.3	4.9	2.4	1.4	0.4	-0-	-0-	0.4	1.6	3.5	6.7	35.2
	Eff. Precip.	5.9	5.0	3.9	1.9	1.1	0.3	-0-	-0-	0.3	1.4	2.8	5.4	28.0
	Veg. Reqm't.	-0-	-0-	-0-	1.7	3.7	5.3	6.0	5.3	3.8	1.4	-0-	-0-	27.2
	Site Reqm't.	-0-	-0-	-0-	2.4	5.3	7.6	8.6	7.6	5.4	2.0	-0-	-0-	38.9
21.1	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.8
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.5	3.1	1.8	1.3	45.2
	Precip.	10.7	9.2	7.1	3.6	2.0	0.5	-0-	-0-	0.5	2.6	5.1	9.7	51.0
	Eff. Precip.	8.6	7.4	5.7	2.9	1.6	0.4	-0-	-0-	0.4	2.1	4.1	7.8	41.0
	Veg. Reqm't.	-0-	-0-	-0-	1.2	3.9	6.0	6.8	5.9	4.1	1.0	-0-	-0-	28.9
	Site Reqm't.	-0-	-0-	-0-	1.7	5.6	8.6	9.7	8.4	5.9	1.4	-0-	-0-	41.3
21.2	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.8
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.5	3.1	1.8	1.3	45.2
	Precip.	12.2	10.5	8.1	4.0	2.3	0.6	-0-	-0-	0.6	2.9	5.8	11.0	58.0
	Eff. Precip.	9.8	8.4	6.5	3.2	1.8	0.5	-0-	-0-	0.5	2.3	4.6	8.8	46.4
	Veg. Reqm't.	-0-	-0-	-0-	0.9	3.7	5.9	6.8	5.9	4.0	0.8	-0-	-0-	28.0
	Site Reqm't.	-0-	-0-	-0-	1.3	5.3	8.4	9.7	8.4	5.7	1.1	-0-	-0-	39.9
21.3	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.8
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.5	3.1	1.8	1.3	45.2
	Precip.	7.5	6.6	5.2	2.6	1.5	0.4	-0-	-0-	0.4	1.8	4.0	7.0	37.0
	Eff. Precip.	6.0	5.3	4.2	2.1	1.2	0.3	-0-	-0-	0.3	1.4	3.2	5.6	29.6
	Veg. Reqm't.	-0-	-0-	-0-	2.0	4.3	6.1	6.8	5.9	4.2	1.7	-0-	-0-	31.0
	Site Reqm't.	-0-	-0-	-0-	2.9	6.2	8.7	9.7	8.4	6.0	2.4	-0-	-0-	43.3
27.1, .3, .4	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.8
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.6	3.1	1.8	1.3	45.3
	Precip.	4.2	3.6	2.9	1.5	0.6	0.1	-0-	-0-	0.2	0.8	1.5	3.6	19.0
	Eff. Precip.	3.4	2.9	2.3	1.2	0.5	0.1	-0-	-0-	0.2	0.6	1.2	2.9	15.3
	Veg. Reqm't.	-0-	-0-	0.4	2.9	5.0	6.3	6.8	5.9	4.4	2.5	0.6	-0-	34.8
	Site Reqm't.	-0-	-0-	0.6	4.1	7.1	9.0	9.7	8.4	6.3	3.6	0.9	-0-	49.7
27.2, .4, .5	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.7
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.6	3.1	1.8	1.3	45.3
	Precip.	2.9	2.5	2.0	1.0	0.4	0.1	-0-	-0-	0.1	0.5	1.0	2.5	13.0
	Eff. Precip.	2.3	2.0	1.6	0.8	0.3	0.1	-0-	-0-	0.1	0.4	0.8	2.0	10.4
	Veg. Reqm't.	-0-	-0-	1.1	3.3	5.2	6.3	6.8	5.9	4.5	2.7	1.0	-0-	36.8
	Site Reqm't.	-0-	-0-	1.6	4.7	7.4	9.0	9.7	8.4	6.4	3.9	1.4	-0-	52.5
28.1,	Pan Evap.	1.6	2.2	3.2	4.9	6.5	7.6	8.1	7.0	5.4	3.8	2.2	1.6	54.0
	PET	1.1	1.5	2.2	3.4	4.6	5.3	5.7	4.9	3.8	2.9	1.5	1.1	38.0
	Precip.	8.2	7.0	5.5	2.7	1.5	0.4	-0-	-0-	0.4	1.9	4.0	7.4	39.0

	Veg. Reqm't.	-0-	-0-	-0-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Site Reqm't.	-0-	-0-	-0-	2.9	6.2	8.7	9.7	8.4	6.0	2.4	-0-	-0-	43.3
27.1, .3, .4	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.8
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.6	3.1	1.8	1.3	45.3
	Precip.	4.2	3.6	2.9	1.5	0.6	0.1	-0-	-0-	0.2	0.8	1.5	3.6	19.0
	Eff. Precip.	3.4	2.9	2.3	1.2	0.5	0.1	-0-	-0-	0.2	0.6	1.2	2.9	15.3
	Veg. Reqm't.	-0-	-0-	0.4	2.9	5.0	6.3	6.8	5.9	4.4	2.5	0.6	-0-	34.8
	Site Reqm't.	-0-	-0-	0.6	4.1	7.1	9.0	9.7	8.4	6.3	3.6	0.9	-0-	49.7
27.2, .4, .5	Pan Evap.	1.9	2.6	3.9	5.8	7.8	9.1	9.7	8.4	6.5	4.5	2.6	1.9	64.7
	PET	1.3	1.8	2.7	4.1	5.5	6.4	6.8	5.9	4.6	3.1	1.8	1.3	45.3
	Precip.	2.9	2.5	2.0	1.0	0.4	0.1	-0-	-0-	0.1	0.5	1.0	2.5	13.0
	Eff. Frecip.	2.3	2.0	1.6	0.8	0.3	0.1	-0-	-0-	0.1	0.4	0.8	2.0	10.4
	Veg. Paqm't.	-0-	-0-	1.1	3.3	5.2	6.3	6.8	5.9	4.5	2.7	1.0	-0-	36.8
	Site Reqm't.	-0-	-0-	1.6	4.7	7.4	9.0	9.7	8.4	6.4	3.9	1.4	-0-	52.5
28.1, .2, .3	Pan Evap.	1.6	2.2	3.2	4.9	6.5	7.6	8.1	7.0	5.4	3.8	2.2	1.6	54.0
	PET	1.1	1.5	2.2	3.4	4.6	5.3	5.7	4.9	3.8	2.9	1.5	1.1	38.0
	Precip.	8.2	7.0	5.5	2.7	1.5	0.4	-0-	-0-	0.4	1.9	4.0	7.4	39.0
	Eff. Precip.	6.6	5.6	4.4	2.2	1.2	0.3	-0-	-0-	0.3	1.5	3.2	5.9	31.2
	Veg. Reqm't.	-0-	-0-	-0-	1.2	3.4	5.0	5.7	4.9	3.5	1.4	-0-	-0-	25.1
	Site Reqm't.	-0-	-0-	-0-	1.7	4.9	7.1	8.1	7.0	5.0	2.0	-0-	-0-	35.8
42.1, .4	Pan Evap.	1.3	1.3	2.6	4.5	7.8	10.4	11.6	10.4	7.1	4.5	1.9	1.3	64.7
	PET	0.9	0.9	1.8	3.2	5.5	7.3	8.1	7.3	5.0	3.2	1.3	0.9	45.4
	Precip.	2.2	2.0	1.8	0.9	0.4	0.1	-0-	-0-	0.2	0.5	1.1	1.8	11.0
	Eff. Precip.	1.8	1.6	1.4	0.7	0.3	0.1	-0-	-0-	0.2	0.4	0.9	1.4	8.8
	Veg. Reqm't.	-0-	-0-	0.4	2.5	5.2	7.2	8.1	7.3	4.8	2.8	0.4	-0-	38.7
	Site Reqm't.	-0-	-0-	0.6	3.6	7.4	10.3	11.6	10.4	6.9	4.0	0.6	-0-	55.4
42.2, .4	Pan Evap.	1.3	1.3	2.6	4.5	7.8	10.4	11.6	10.4	7.1	4.5	1.9	1.3	64.7
	PET	0.9	0.9	1.8	3.2	5.5	7.3	8.1	7.3	5.0	3.2	1.3	0.9	45.4
	Precip.	3.6	3.2	2.9	1.5	0.7	0.2	-0-	-0-	0.3	0.9	1.8	2.9	18.0
	Eff. Precip.	2.9	2.6	2.3	1.2	0.6	0.2	-0-	-0-	0.2	0.7	1.4	2.3	14.4
	Veg. Reqm't.	-0-	-0-	-0-	2.0	4.9	7.1	8.1	7.3	4.8	2.5	-0-	-0-	36.7
	Site Reqm't.	-0-	-0-	-0-	2.9	7.0	10.1	11.6	10.4	6.9	3.6	-0-	-0-	52.5
42.3, .4	Pan Evap.	1.3	1.3	2.6	4.5	7.8	10.4	11.7	10.4	7.1	4.5	1.9	1.3	64.8
	PET	0.9	0.9	1.8	3.2	5.5	7.3	8.2	7.3	5.0	3.2	1.3	0.9	45.5
	Precip.	2.6	2.3	2.1	1.0	0.5	0.2	-0-	-0-	0.2	0.7	1.3	2.1	13.0
	Eff. Precip.	2.1	1.8	1.7	0.8	0.4	0.2	-0-	-0-	0.2	0.6	1.0	1.7	10.5
	Veg. Reqm't.	-0-	-0-	0.1	2.4	5.1	7.1	8.2	7.3	4.8	2.6	0.3	-0-	37.9
	Site Reqm't.	-0-	-0-	0.1	3.4	7.3	10.1	11.7	10.4	6.9	3.7	0.4	-0-	54.0
43.1	Pan Evap.	1.3	1.3	2.6	4.5	7.6	10.2	11.4	10.2	7.0	4.5	1.9	1.3	63.6
	PET	0.9	0.9	1.8	3.2	5.3	7.1	8.0	7.1	4.9	3.2	1.3	0.9	44.6
	Precip.	2.2	2.0	1.8	0.9	0.4	0.1	-0-	-0-	0.2	0.5	1.1	1.8	11.0
	Eff. Precip.	1.8	1.6	1.4	0.7	0.3	0.1	-0-	-0-	0.2	0.4	0.9	1.4	8.8
	Veg. Reqm't.	-0-	-0-	0.4	2.5	5.0	7.0	8.0	7.1	4.7	2.8	0.4	-0-	37.9
	Site Reqm't.	-0-	-0-	0.6	3.6	7.1	10.0	11.4	10.1	6.7	4.0	0.6	-0-	54.1
43.2	Pan Evap.	1.3	1.3	2.6	4.5	7.6	10.2	11.4	10.2	7.0	4.5	1.9	1.3	63.6
	PET	0.9	0.9	1.8	3.2	5.3	7.1	8.0	7.1	4.9	3.2	1.3	0.9	44.6
	Precip.	2.6	2.3	2.1	1.0	0.5	0.2	-0-	-0-	0.2	0.7	1.3	2.1	13.0
	Eff. Precip.	2.1	1.8	1.7	0.8	0.4	0.2	-0-	-0-	0.2	0.6	1.0	1.7	10.5
	Veg. Reqm't.	-0-	-0-	0.1	2.4	4.9	6.9	8.0	7.1	4.7	2.6	0.3	-0-	37.0
	Site Reqm't.	-0-	-0-	0.1	3.4	7.0	9.9	11.4	10.1	6.7	3.7	0.4	-0-	52.7

(From Vol. II, Table II-E-6, Pg. E-29)

PBQ&D, Inc.

NOTES:

1/ Pan Evaporation, from Bulletin 113-2, California Department of Water Resources.

2/ Potential Evapotranspiration, 0.7 x Pan Evap. (see pages 51 to 69, Bulletin 113-2)

3/ Precipitation, interpolated from iso-hyetal maps provided by the Corps of Engineers, San Francisco.

4/ Effective Precipitation, 0.8 x Precip.

5/ Vegetation Requirement, PET - Eff. Precip. (positive values only)

6/ Site Requirement, Veg. Reqm't./0.7

variations in observed average oxidant levels may be attributed to meteorological variations, the general trend toward cleaner air must in part be attributed to more stringent control of emission sources. It is therefore reasonable to assume that the trend of decreasing observed oxidant levels will continue with continued source control.

A useful index of general air quality in an area is the number of instances of oxidant levels exceeding a certain standard over a period of time. The common expression of high oxidant level occurrence frequency is the number of days per year with high hourly oxidant at or above indicated levels. Oxidant level designations for the Bay Area are given below (Ref. 143:)

	Oxidant Level (ppm)
Clean Air	.00 - .05
Light Air Pollution	.06 - .09
Significant Air Pollution	.10 - .15
Heavy Air Pollution	.16 - .25
Severe Air Pollution	above .25
Emergency	above .60

Relative air quality in a site is indicated by the number of days per year with oxidant levels reaching the .10 ppm standard. Geographic distributions of high hour oxidant days prepared by the Bay Area Air Pollution Control District from 1971 data indicate that the frequency of .10 ppm oxidant days for areas along the coast is less than 5 per year while some areas in the Livermore Valley exceed 50 days per year.

e. The California Protected Waterways Plan

The California Protected Waterways Plan (Initial Elements, 1971) is the first report to the California Legislature concerning the investigations carried out under the California Protected Waterways Program as required by the Protected Waterways Act of 1968. Part of the program required, "the identification of those waterways of the state possessed of extraordinary scenic, fishery, wildlife or outdoor recreation resources." The term "waterways" was defined by the California Protected Waterways Act to include, "the waters and adjacent lands of streams, channels, lakes, wetlands and lagoons." The report identified and classified the extraordinary waterways for each of the major categories: scenic, fishery, wildlife and recreation. A master list of extraordinary waterways was compiled for these individual evaluations.

The California Protected Waterways Plan was followed in this study to identify the extraordinary waterways in each potential land application area and to rate them at to relative improtance for each major category.

The classification system used in the California Protected Waterways Plan to evaluate the waterways is as follows:

"Class I - Premium waterways. Statewide interest and importance usually involved; attract visitors from throughout the State.

"Class II - Very good waterways. Regional interest and importance usually involved; attract visitors from a less than statewide area, normally within about a 200-mile radius. These waterways have high values...but they rank just below those of Class I.

"Class III - Important waterways. County-wide interest and importance usually involved; used primarily by residents of the county. Cirteria evaluation ranks these just below those of Class II."

The criteria used for evaluating and rating each waterway are as follows:

1. The size, present and potential ability to produce and support fish and wildlife populations;
2. The quality and quantity of the fishery and wildlife resources produced;
3. The presence of rare or endangered species;
4. Present and future potential human use (quality and quantity) including scientific and education pursuits;
5. Present and future availability of the waterway for public use;
6. Presence of critical environmental requirements;
7. Geographical location related to scarcity;
8. Aesthetic condition; and
9. Access, condition and facilities.

The four major categories are subdivided based on type of waterway, type of resources, scenic quality or recreation usuage. Farm ponds throughout the state are classified as Class I lakes and reservoirs in the wildlife waterway evaluations. Waterways within each potential wastewater management study area have been recorded as to their classification in the California Protected Waterways Plan.

f. California State Scenic Highway System

Before a proposed highway route can be officially designated as part of the State Scenic Highway System, the following prerequisites must be met:

1. A general plan with included map must be drawn up for the area outlining the environmental controls that will be in effect.

2. A specific plan and map for the specific development proposals within the area and guidelines that will be in effect must be completed. This specific plan may replace the general plan mentioned above.

3. A billboard ordinance must be in effect along the corridor to limit or forbid out-of-the-area advertising.

4. A land use regulation system or zoning ordinance with proper scenic restrictions must be adopted by the local governmental agency concerned.

The width of the actual scenic corridor along the scenic highway is optional; it should vary depending on topography and field of vision. This is generally decided on by the local controlling body and the California Division of Highways regional controller (Ref. 60.)

A number of roadways within the potential land application sites have been designated as included within the California State Scenic Highway System or have been proposed for such inclusion and are discussed in several of the following chapters.

4 - Selected Sites

Locations of the selected sites are shown in Figure V-A-7, and area designations for the sites are given below:

Site 4 - Grizzly Island Wildlife Refuge
Site 5 - Northern Yolo County - Woodland
Site 18 - Northern Marin, Southern Sonoma Counties Coast
Site 21 - Northeastern Sonoma County - Healdsburg
Site 27 - Salinas Valley Area
Site 28 - Southern San Mateo County Coast
Site 42 - Southeastern Contra Costa County
Site 43 - San Joaquin County - Union and Roberts Islands

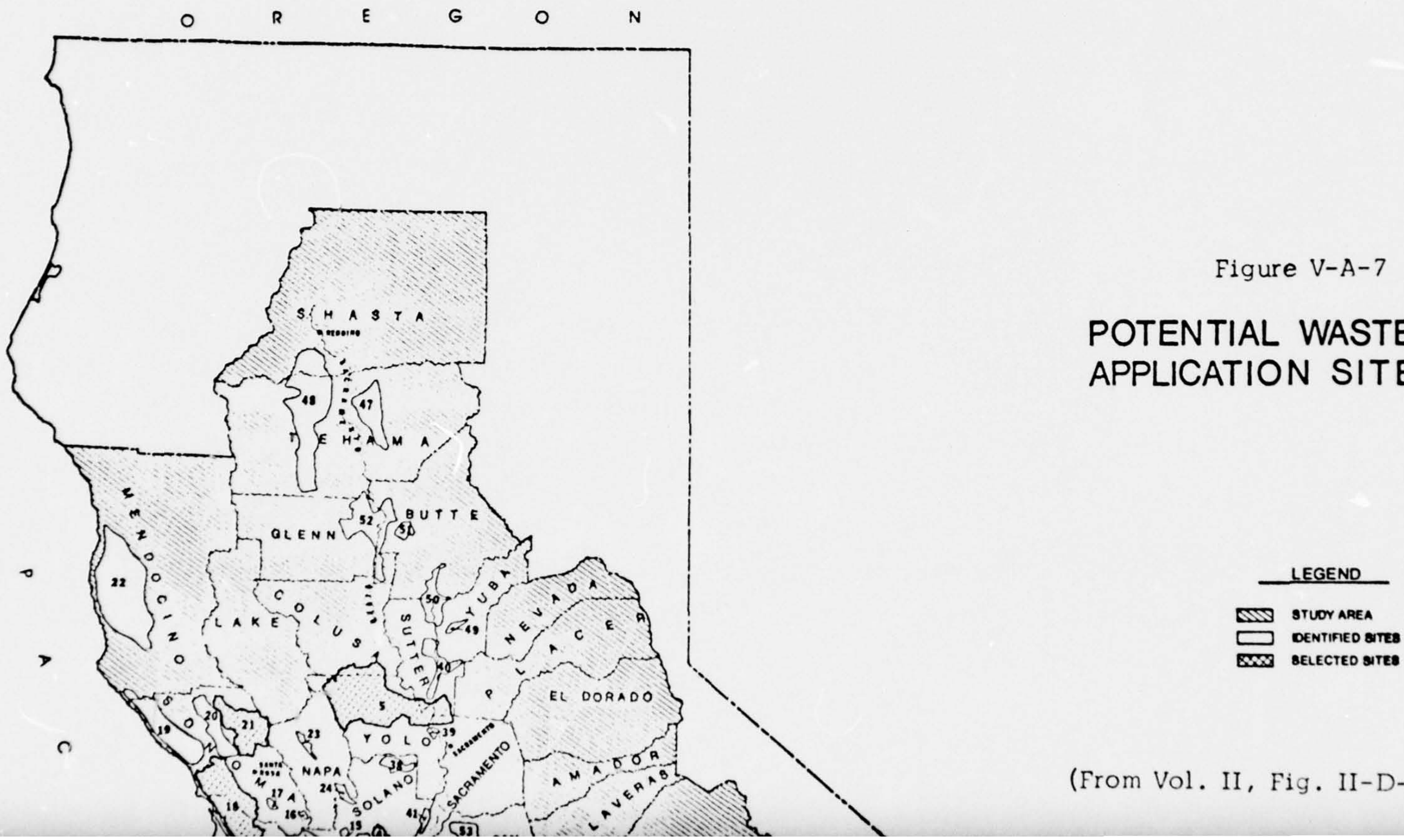

Figure V-A-7

POTENTIAL WASTEWATER APPLICATION SITE MAP

(From Vol. II, Fig. II-D-1, Pg. D-5)

(From Vol. II, Fig. II-D-1, Pg. D-5)

5 - Development Objectives

Each of the sites assessed in this report has characteristics which will effect wastewater treatment and, with managed wastewater application and drainage, would generate a desired enviromental and/or economic benefit. The opportunities for achieving objectives in these sites are expected to be representative of opportunities exhibited by other sites identified but not evaluated. A more detailed discussion of development objectives is provided in section 1b of each of the following eight site evaluation chapters (B through I.)

6 - Previous Studies and Data Sources

This report draws upon the information and conclusions presented in previous reports completed by the Corps of Engineers and by other Federal, state, and local agencies.

The Feasibility Report, "Alternatives for Managing Wastewater in the San Francisco Bay and Sacramento-San Joaquin Delta Area:" The completion in July 1971 of the above identified feasibility report (Ref. 1) by the San Francisco Engineer District, U.S. Army Corps of Engineers, represented the completion of the first phase of the Pilot Wastewater Management Program for the San Francisco Bay and Sacramento-San Joaquin Delta region. The stated objective of the feasibility study, "...to consider the problem of regional wastewater management; to investigate the opportunity offered by regional wastewater management; and to explore the need for subsequent more detailed study of the problem." The conclusions of the feasibility report set the stage for the studies described in this report and its data were used in carrying out the studies.

Consultant Report, Volumes I, II, III, and IV of the "San Francisco Bay-Delta Wastewater and Residual Solids Management Study:" These reports were completed by PBQ&D, Inc. under previous contracts with the Corps in support of their study program. An inventory was made of lands in the 39-county Study Area and specific land sites were identified which were considered suitable to receive secondary level treated wastewaters for land application by irrigation. Certian selected representative sites were subsequently evaluated as to the degree of suitability for wastewater application. Also a summary and projection of systems methodology for wastewater sludges and residual solids handling and disposal was developed. Volumes II and IV have provided the largest amount of information directly pertinent to this environmental impact assessment study.

Federal, State, and Local Agencies: Several Federal, State, and local agencies were contacted for various additional, updating, or new information pertinent to this report. The most significant of these are listed as follows:

Federal.

1. U.S. Army Corps of Engineers, San Francisco Engineer District; aerial photographs of Study Sites 4, 18, 21, 28, 42, and 43 and miscellaneous information concerning rare and endangered species.

2. U.S. Geological Survey; topographic maps.

State.

3. California Regional Water Quality Control Boards for the Central Valley, San Francisco Bay, and North Coast Regions; interim water quality control plans and incidental informally transmitted information concerning water quality conditions.

4. California State Department of Parks and Recreation; information concerning registered historical landmarks and current and projected recreation plans.

5. California State Department of Fish and Game; miscellaneous information concerning fish and wildlife conditions, diseases, and specifically concerning management policies for the Grizzley Island Wildlife Refuge.

6. Bay Area and Yolo-Solano Air Pollution Control Districts; miscellaneous information concerning air quality conditions.

Local.

7. Sonoma and Yolo Counties Parks Department or Parks and Recreation Departments; miscellaneous information concerning the location of historical landmarks.

8. Planning Departments of Marin, San Mateo, Sonoma, and Contra Costa Counties; miscellaneous information concerning future land-uses.

7 - Study Approach and Methods

a. Wastewater Management Policies

This assessment assumes the following conditions:

1. All lands within each selected site which are considered suitable for wastewater land application will be developed for this purpose.

2. The estimated quantities of treated combined municipal and industrial wastewaters for the project year 2000 and estimated major water quality parameters are those presented in Table V-A-5. The concentrations assume conventional secondary levels of treatment. This treatment is illustrated in the flow diagram of Figure V-A-8. A review of Table V-A-5 indicates the estimated effect of industrial wastewaters on the quality of the wastewaters for each county. This information provides the basis for recommendations for separate treatment of certain industrial wastewaters.

3. Sufficient storage capacity will be available in the treatment plants and in the collection and conveyance systems to effectively eliminate any significant variations in either the quantity or the quality of treated wastewaters available for land application by irrigation.

4. The application rates are those recommended in Tables V-A-6 and V-B-1. Those for Site 4 are presented separately in Table V-B-1 because of this site's special characteristics.

5. The water quality of wastewaters recovered from land applications is that estimated in Table V-A-7.

b. Land Uses

Four general categories of vegetation have been selected for the range of soils occurring in the sites investigated. These and associated soil types are shown in Table V-A-9. Recommended vegetative covers for the selected land application study sites are given in Table V-A-10 and V-B-2 and are shown in the maps in the appropriate figures in the subsequent chapters of this report dealing with each of the selected study sites. With very few exceptions, the recommended vegetative cover closely parallels existing land uses.

Alternative future land uses in the various sub-areas of the selected land application study sites correspond to specified objectives of wastewater application. These objectives include the following:

Table V-A-5

TREATED COMBINED MUNICIPAL AND INDUSTRIAL WASTEWATERS - YEAR 2000 1/

COUNTY	FLOW (MGD)	CHARACTERISTICS - mg/l							
		BOD	TN 2/	TP	TSS	TDS	Phenols	GHM	O&G
San Francisco	130	46	75	15	28	530	---	1.5	11.1
San Mateo	98 (90)	42 (45)	69 (75)	15	39 (38)	545 (528)	0.0005	1.3 (1.5)	10.2 (10.7)
Santa Clara	350	46	75	15	28	530	---	1.5	10.8
Alameda	208 (195)	44 (46)	70 (74)	18 (15)	29 (28)	550 (528)	---	1.4 (1.5)	9.9 (10.5)
Marin	60	38	62	13	22	400	---	1.0	7.8
Sonoma	45	37	62	11	21	400	---	1.1	8.1
Napa	21 (20)	34 (36)	56 (60)	12	23 (24)	410 (396)	---	22.0 (1.2)	12.0
Solano	71 (60)	57 (38)	106 (62)	11 (12)	19 (22)	510 (398)	0.006	5.7 (1.0)	15.3 (8)
Contra Costa	347 (120)	55 (40)	141 (66)	20 (9)	24	1000 (460)	0.010	3.0 (1.3)	14.1 (9)
Yolo	40 (38)	39 (38)	50 (54)	13	22	420 (403)	---	1.3	9.0 (9.5)
Sacramento	161 (160)	37	55	12	22	420 (404)	---	1.1	8.3
San Joaquin	77 (45)	34 (37)	33 (56)	7 (11)	29 (21)	770 (404)	---	0.7 (1.1)	4.8 (8.0)
Total or Average	1,608	46	84	15	26	622	---	2.1	10.8

(From Vol. II, Table II-B-10, Pg. B-15)

NOTES:

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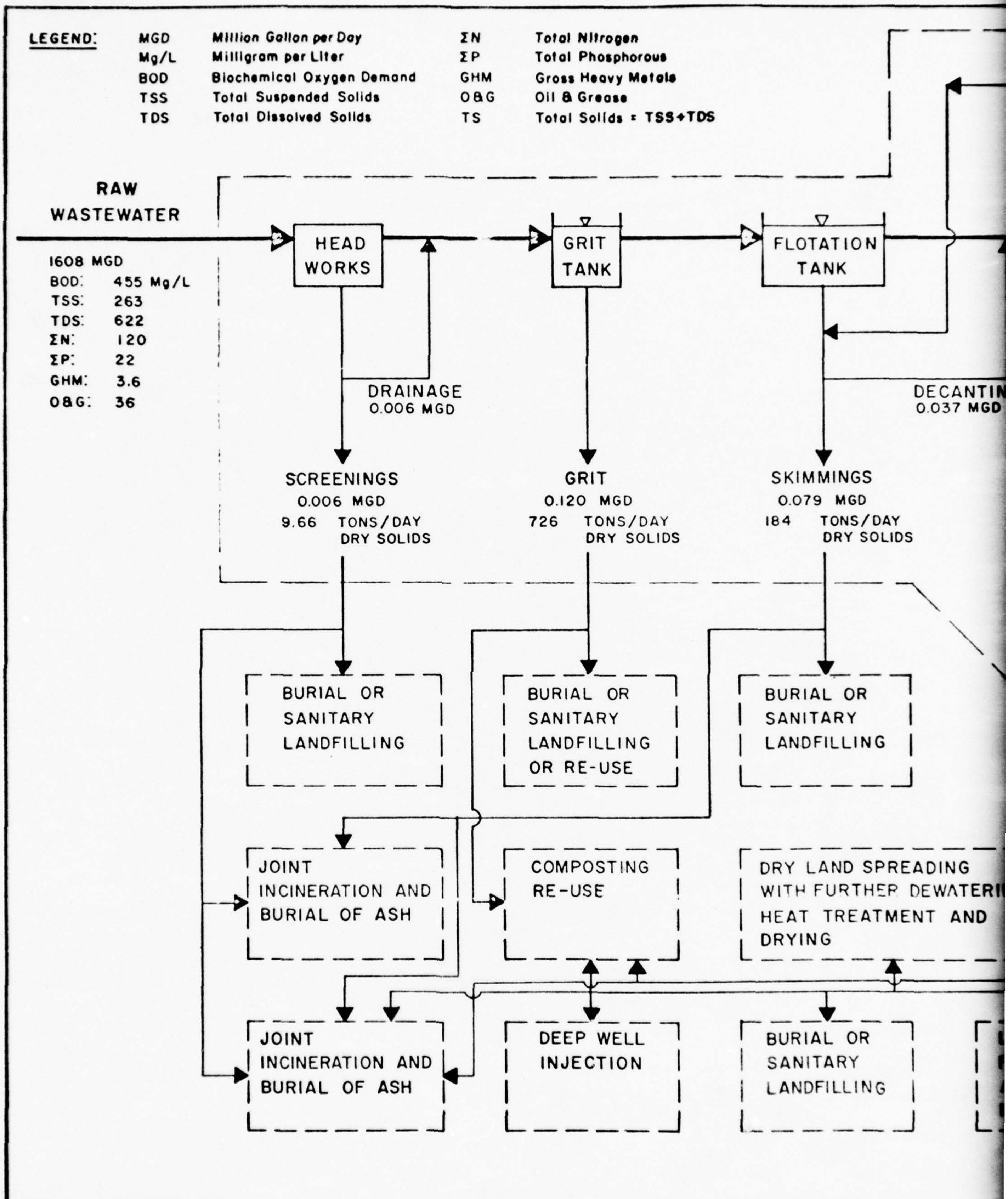
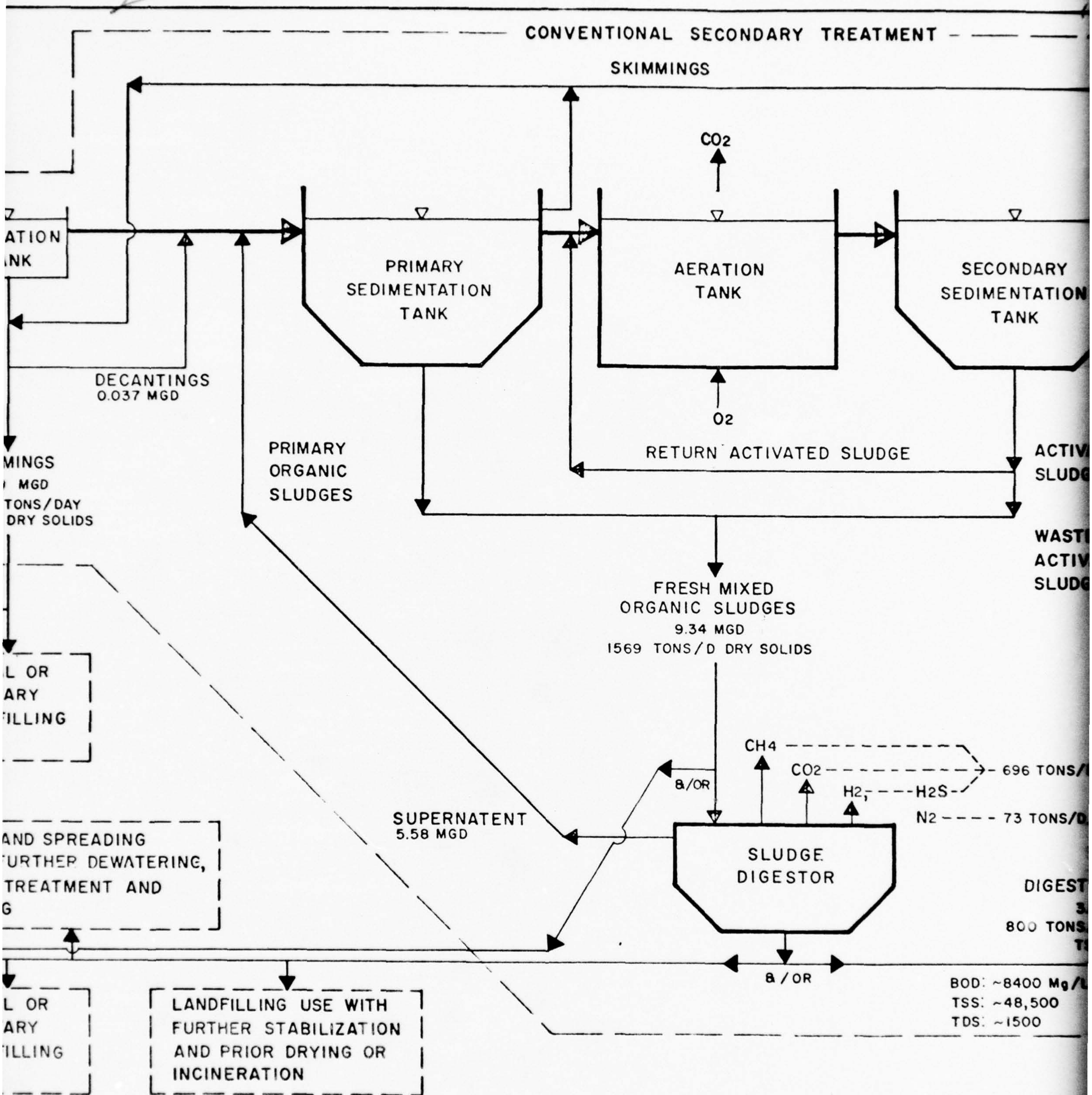
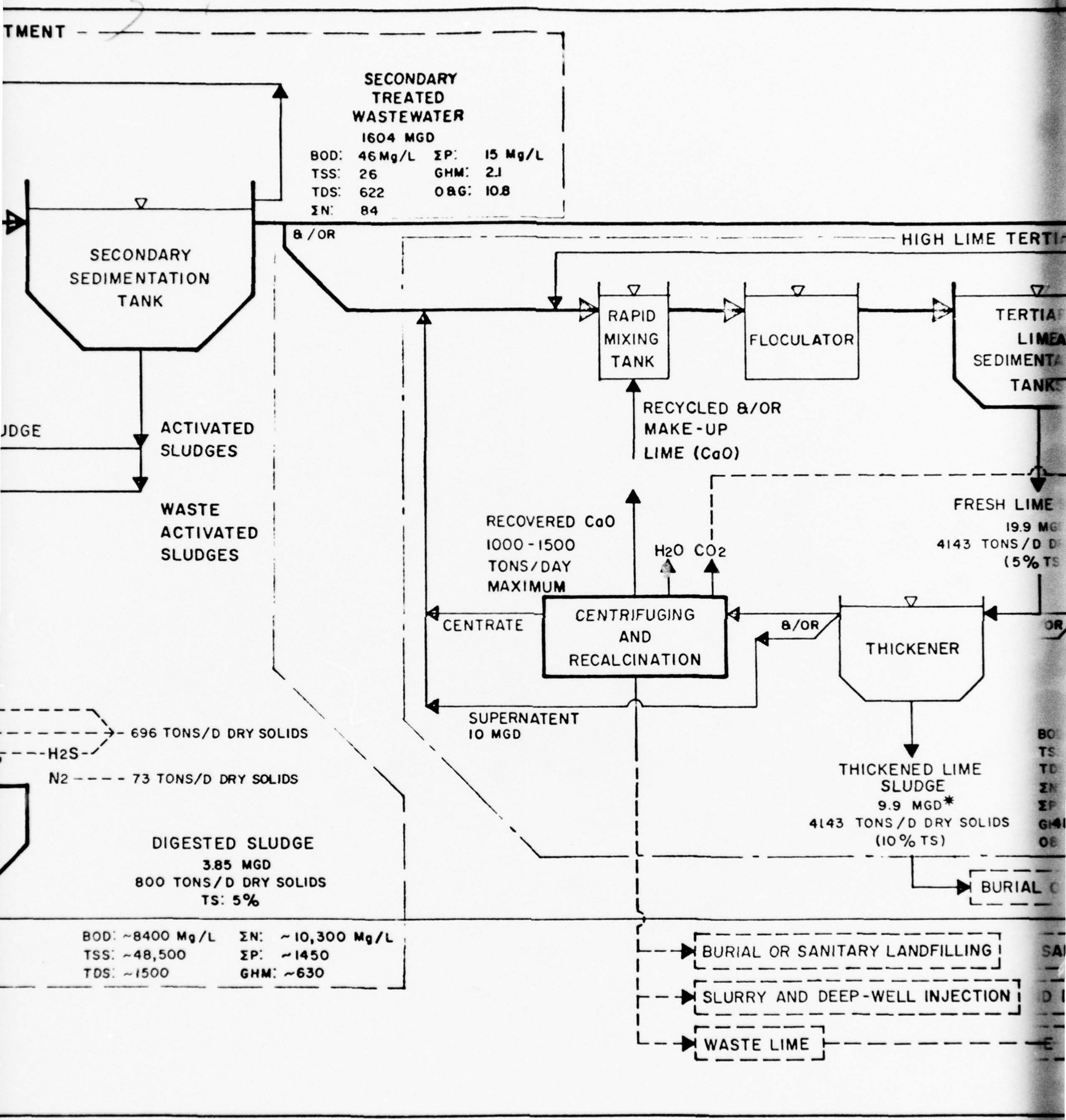
1/ Water quality values for treated municipal wastewaters, where different from those for combined municipal and industrial wastewaters, are shown in brackets.

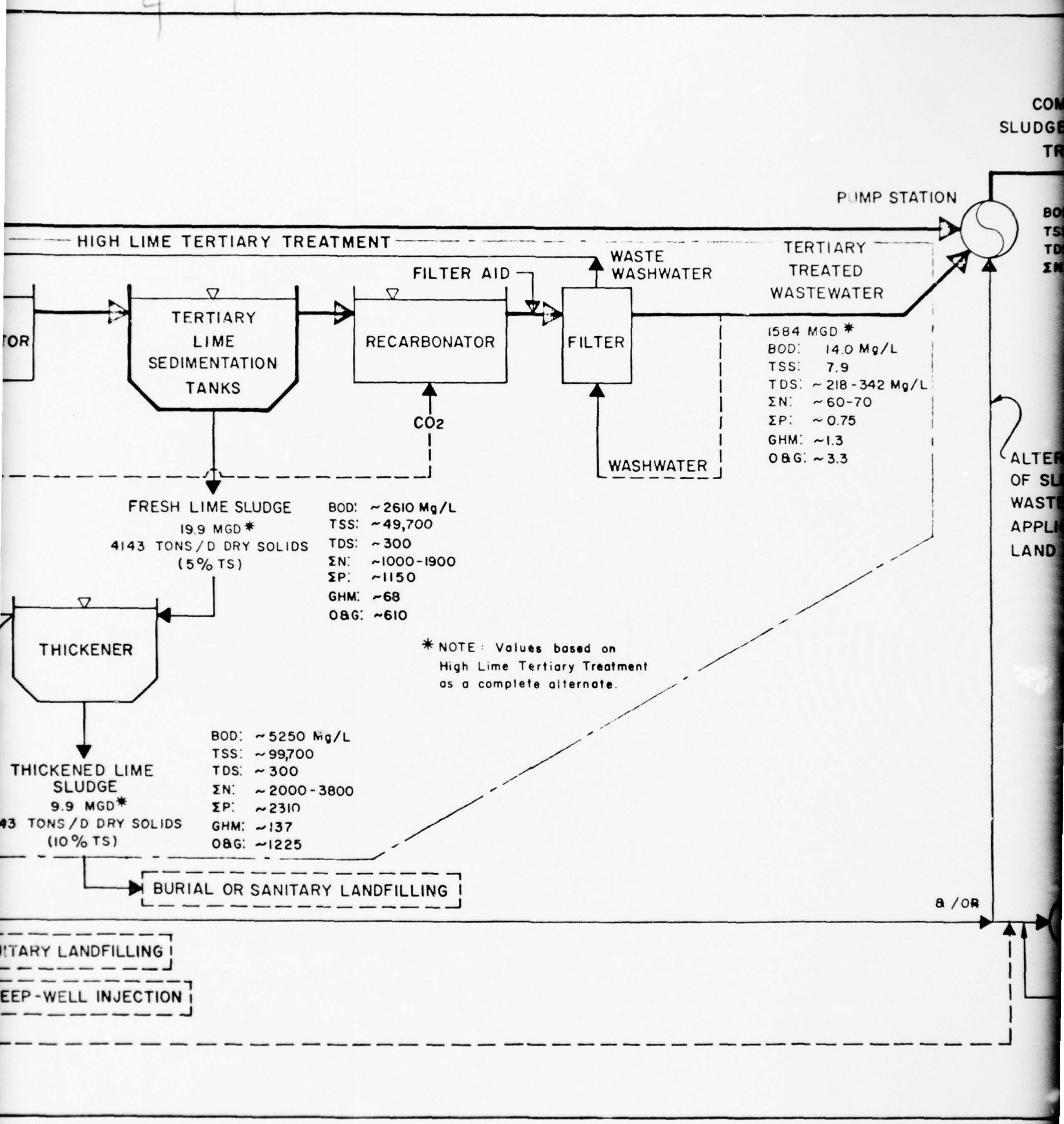
2/ The most recent estimates indicate that these projected TN concentrations may be reducable to 30 percent of listed values. This will affect TN values given in Figure V-A-8 and Table V-A-7.



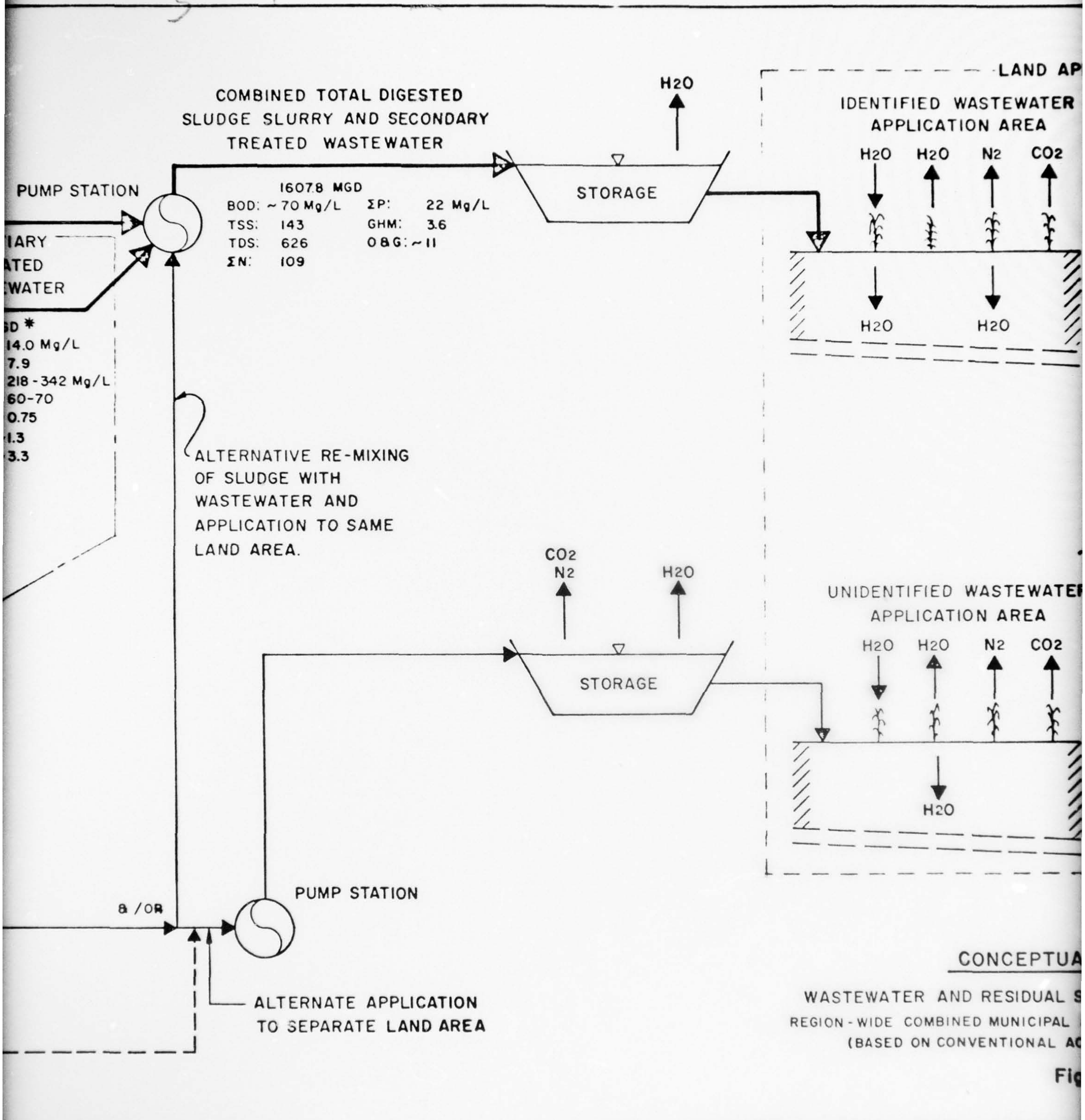
LEGEND:
MGD Million Gallon per Day
Mg/L Milligram per Liter
BOD Biochemical Oxygen Demand
TSS Total Suspended Solids
TDS Total Dissolved Solids
ΣN Total Nitrogen
ΣP Total Phosphorous
GHM Gross Heavy Metals
O&G Oil & Grease
TS Total Solids = TSS+TDS
RAW WASTEWATER
1608 MGD
BOD: 455 Mg/L
TSS: 263
TDS: 622
ΣN: 120
ΣP: 22
GHM: 3.6
O&G: 36
HEAD WORKS
GRIT TANK
FLOTATION TANK
DRAINAGE 0.006 MGD
DECANTIN
0.037 MGD
SCREENINGS
0.006 MGD
9.66 TONS/DAY DRY SOLIDS
GRIT
0.120 MGD
726 TONS/DAY DRY SOLIDS
SKIMMINGS
0.079 MGD
184 TONS/DAY DRY SOLIDS
BURIAL OR SANITARY LANDFILLING
BURIAL OR SANITARY LANDFILLING OR RE-USE
BURIAL OR SANITARY LANDFILLING
JOINT INCINERATION AND BURIAL OF ASH
COMPOSTING RE-USE
DRY LAND SPREADING WITH FURTHER DEWATERI
HEAT TREATMENT AND DRYING
JOINT INCINERATION AND BURIAL OF ASH
DEEP WELL INJECTION
BURIAL OR SANITARY LANDFILLING


CONVENTIONAL SECONDARY TREATMENT
SKIMMINGS
CO_2
ATION
NK
PRIMARY SEDIMENTATION TANK
AERATION TANK
SECONDARY SEDIMENTATION TANK
DECANTINGS
0.037 MGD
O_2
MINGS
MGD
TONS/DAY
DRY SOLIDS
PRIMARY ORGANIC SLUDGES
RETURN ACTIVATED SLUDGE
FRESH MIXED ORGANIC SLUDGES
9.34 MGD
1569 TONS/D DRY SOLIDS
L OR
ARY
FILLING
CH_4
CO_2
H_2
H_2S
696 TONS/
N_2
73 TONS/D
&/OR
SUPERNATENT
5.58 MGD
AND SPREADING
FURTHER DEWATERING,
TREATMENT AND
G
SLUDGE DIGESTOR
DIGEST
800 TONS
&/OR
BOD: ~8400 Mg/
TSS: ~48,500
TDS: ~1500
L OR
ARY
FILLING
LANDFILLING USE WITH FURTHER STABILIZATION AND PRIOR DRYING OR INCINERATION


TMENT
3
SECONDARY TREATED WASTEWATER
1604 MGD
BOD: 46 Mg/L ΣP: 15 Mg/L
TSS: 26 GHM: 2.1
TDS: 622 O&G: 10.8
ΣN: 84
& /OR
HIGH LIME TERTI
SECONDARY SEDIMENTATION TANK
RAPID MIXING TANK
FLOCULATOR
TERTIA LIME SEDIMENTA TANKS
RECYCLED &/OR MAKE-UP LIME (CaO)
UDGE
ACTIVATED SLUDGES
WASTE ACTIVATED SLUDGES
RECOVERED CaO
1000-1500 TONS/DAY MAXIMUM
H_2O CO_2
FRESH LIME
19.9 MG
4143 TONS/D D
(5% TS
CENTRATE
CENTRIFUGING AND RECALCINATION
&/OR
THICKENER
OR
SUPERNATENT
10 MGD
696 TONS/D DRY SOLIDS
H_2S
N_2 73 TONS/D DRY SOLIDS
THICKENED LIME SLUDGE
9.9 MGD*
4143 TONS/D DRY SOLIDS
(10% TS)
DIGESTED SLUDGE
3.85 MGD
800 TONS/D DRY SOLIDS
TS: 5%
BURIAL
BOD: ~8400 Mg/L ΣN: ~10,300 Mg/L
TSS: ~48,500 ΣP: ~1450
TDS: ~1500 GHM: ~630
BURIAL OR SANITARY LANDFILLING
SLURRY AND DEEP-WELL INJECTION
WASTE LIME



4
COM
SLUDGE
TR
PUMP STATION
BO
TS
TD
ΣN
HIGH LIME TERTIARY TREATMENT
WASTE WASHWATER
TERTIARY TREATED WASTEWATER
FILTER AID
TERTIARY LIME SEDIMENTATION TANKS
RECARBONATOR
FILTER
TOR
CO2
WASHWATER
1584 MGD *
BOD: 14.0 Mg/L
TSS: 7.9
TDS: ~218-342 Mg/L
ΣN: ~60-70
ΣP: ~0.75
GHM: ~1.3
O&G: ~3.3
ALTER
OF SL
WASTE
APPLI
LAND
FRESH LIME SLUDGE
19.9 MGD *
4143 TONS/D DRY SOLIDS
(5% TS)
BOD: ~2610 Mg/L
TSS: ~49,700
TDS: ~300
ΣN: ~1000-1900
ΣP: ~1150
GHM: ~68
O&G: ~610
THICKENER
* NOTE: Values based on High Lime Tertiary Treatment as a complete alternate.
THICKENED LIME SLUDGE
9.9 MGD *
43 TONS/D DRY SOLIDS
(10% TS)
BOD: ~5250 Mg/L
TSS: ~99,700
TDS: ~300
ΣN: ~2000-3800
ΣP: ~2310
GHM: ~137
O&G: ~1225
BURIAL OR SANITARY LANDFILLING
& /OR
ITARY LANDFILLING
EEP-WELL INJECTION



CONCEPTUA

WASTEWATER AND RESIDUAL S

REGION-WIDE COMBINED MUNICIPAL

(BASED ON CONVENTIONAL AC

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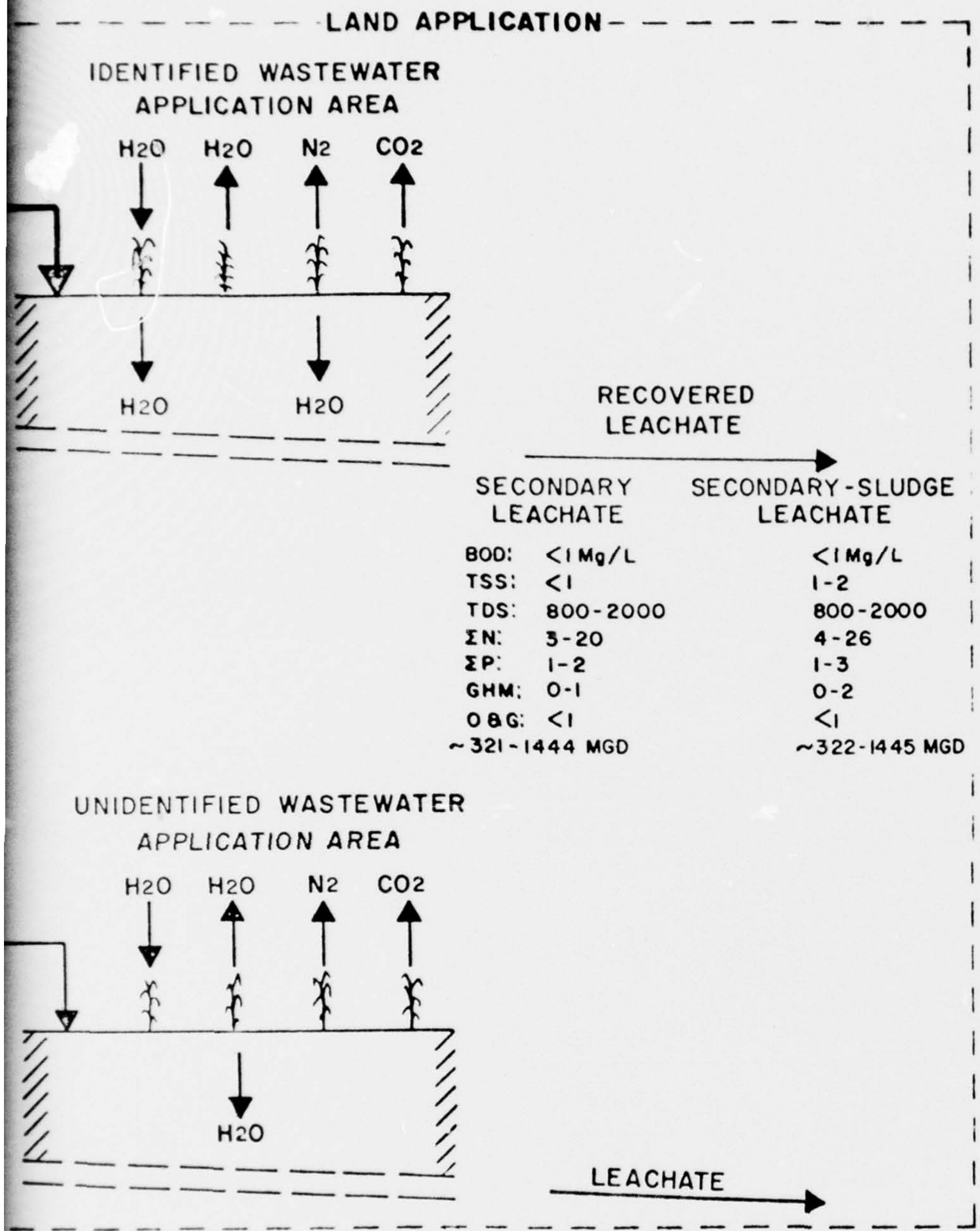

CONCEPTUAL FLOW DIAGRAM

WASTEWATER AND RESIDUAL SOLIDS LAND DISPOSAL ALTERNATIVES

REGION-WIDE COMBINED MUNICIPAL AND INDUSTRIAL WASTEWATERS - YEAR 2000

(BASED ON CONVENTIONAL ACTIVATED SLUDGE TREATMENT SYSTEM)

Figure V-A-8

Table V-A-6

RECOMMENDED UNIT WASTEWATER APPLICATIONS
(acre feet per acre per year)

(From Vol. II, Table II-E-7, Pg. E-31)

Site Sub-Area No.	Distinguishing Feature	Land Use					
		Forest		Pasture		Crops	
		Site Reqm't for Vegetation 1/	Site Reqm't for Leaching 2/	Site Reqm't for Vegetation 1/	Site Reqm't for Leaching 2/	Site Reqm't for Vegetation 1/	Site Reqm't for Leaching 2/
5.1	Capay Valley	3.1	1.9	4.5	0.5	2.4	0.8
5.2	Hungry Hollow	3.5	1.7	4.5	0.5	2.3	0.8
5.3	Dunnigan Hills	3.6	1.8	4.5	0.5	2.4	0.8
5.4	Yolo Plains	4.7	2.1	4.5	0.5	2.4	0.6
5.5	Yolo Bypass	4.7	2.1	4.5	0.5	5.0 3/	0.5
5.6	Sacramento	4.7	2.1	4.5	0.5	3.9 3/	0.5
12.1	Panoche	4.7	2.4	4.8	0.6	3.1	1.0
12.2	Dos Palos	3.9	2.5	4.8	0.6	3.2	1.0
18.1	Sebastopol	3.3	1.5	3.1	0.7	1.5	0.3
18.2	Salmon Creek	3.2	1.4	3.1	0.8	1.4	0.2
18.3	Lagunitas Creek	3.2	1.4	3.1	0.4	1.4	0.3
18.4,5,6	Not specific	3.2	1.4	3.1	0.8	1.5	0.6
21.1	Alexander Valley	3.4	1.5	3.0	0.4	1.7	0.7
21.2	Knight's Valley	3.3	1.5	3.0	0.4	1.7	0.7
21.3	Windsor	3.6	1.6	3.0	0.4	1.7	0.7
27.1	Gabilan Creek	3.8	1.8	4.5	0.6	2.8	0.9
27.2	Quail Creek	3.0	2.0	4.5	0.6	2.9	0.9
27.3,4,5	Not specific	4.1	1.8	4.5	0.6	2.8	0.9
28.1	Pescadero Creek	3.0	1.3	2.8	0.3	2.2	0.8
28.2,3	Not specific	3.0	1.3	2.8	0.3	2.2	0.8

18.3	**Lagunitas Creek**	**3.2**	**1.4**	**3.1**	**0.4**	**1.4**	**0.5**
18.4,5,6	Not specific	3.2	1.4	3.1	0.8	1.5	0.6
21.1	Alexander Valley	3.4	1.5	3.0	0.4	1.7	0.7
21.2	Knight's Valley	3.3	1.5	3.0	0.4	1.7	0.7
21.3	Windsor	3.6	1.6	3.0	0.4	1.7	0.7
27.1	Gabilan Creek	3.8	1.8	4.5	0.6	2.8	0.9
27.2	Quail Creek	3.0	2.0	4.5	0.6	2.9	0.9
27.3,4,5	Not specific	4.1	1.8	4.5	0.6	2.8	0.9
28.1	Pescadero Creek	3.0	1.3	2.8	0.3	2.2	0.8
28.2,3	Not specific	3.0	1.3	2.8	0.3	2.2	0.8
42.1	Deer Valley	---	---	4.5	0.6	2.5	1.0
42.2	Marsh Creek	3.2	2.0	4.5	0.6	2.5	1.0
42.3	Clifton Court Forebay	---	---	4.5	0.6	2.5	0.9
42.4	Not specific	4.4	2.0	4.5	0.6	2.5	1.0
43.1	Roberts Island	---	---	4.3	0.5	2.6	0.8
43.2	Union Island	---	---	4.3	0.5	2.5	0.8

NOTES:

1/ Based on the growing season of each vegetative cover and includes a 30% application loss to surface waste and deep percolation below root zone (see Table V-A-4).

2/ An estimated amount required to maintain the annual salt balance within the tolerance of the recommended vegetative cover. This application should be made during off-season periods.

3/ Includes the effect of rice acreages.

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Table V-A-7

ESTIMATED QUALITY OF RECOVERED WATER 1/

Wastewater Constituent	Applied Water 2/	Surface Drainage	Sub-Surface Drainage or Groundwater	
			Forest, Pasture and Crops	Rapid Infiltration
Biochemical Oxygen Demand (BOD)	30-60	6-12	0.3-0.6	0.3-0.6
Total Nitrogen (TN)	30-100 7/	6-20 7/	3-20 7/	21-70 7/
Total Phosphorus (TP)	10-20	2-4	1-2	1-2
Total Suspended Solids (TSS)	20-40	4-8	0.2-0.4	0.2-0.4
Total Dissolved Solids (TDS)	400-1000	400-1000 3/	800-2000 4/	450-1100 6/
Phenols	---	---	---	---
Gross Heavy Metals (GHM)	1-20	1-16	0-1 5/	0-1
Oil and Grease	5-15	0.3-0.8	0.3-0.8	0.3-0.8
Coliform and Bacteria	---	---	---	---

(From Vol. II, Table II-E-8, Pg. E-39)

NOTES:

1/ Based on Table V-A-8.

2/ See Table V-A-5.

3/ Water would be recycled to adjacent lands for further treatment.

4/ Assumes one-half of the total application is used for evaporation and transpiration. Sub-surface drains are assumed to receive all applied salts.

5/ May be 30% higher depending on the effectiveness of the salt leaching applications in removing heavy metals.

6/ Assumes 10 percent of water is used.

7/ Note: the most recent estimates indicate that these projected TN concentrations may be reducable to 30 percent of those listed.

Table V-A-8

REMOVAL EFFICIENCIES FOR LAND APPLICATION OF WASTEWATERS

	% Removal 2/		
	Spray Irrigation	Overland Runoff	Rapid Infiltration
Biochemical Oxygen Demand (BOD)	98+	98	80-85
Chemical Oxygen Demand (COD)	95+	92	50-60
Nitrogen (N)	85+	80	30-80 3/
Phosphorous (P)	99+	40-80	50-60
Metals	95+	50	50-60
Suspended Solids	99	94	99
Pathogens	99	99	99

(From Vol. II, Table II-C-7, Pg. C-25)

NOTES:

1/ From Ref. 17, P. 30.

2/ The results for spray irrigation are modeled upon research accomplished at Penn State University. For overland runoff, the values listed for BOD, COD, N and suspended solids are reported values of an operation at Paris, Texas. All other values for overland runoff and rapid infiltration are estimates by the CRREL staff.

3/ See Fig. V-A-9.

(From Vol. II, Fig. II-C-7, Pg. C-23)

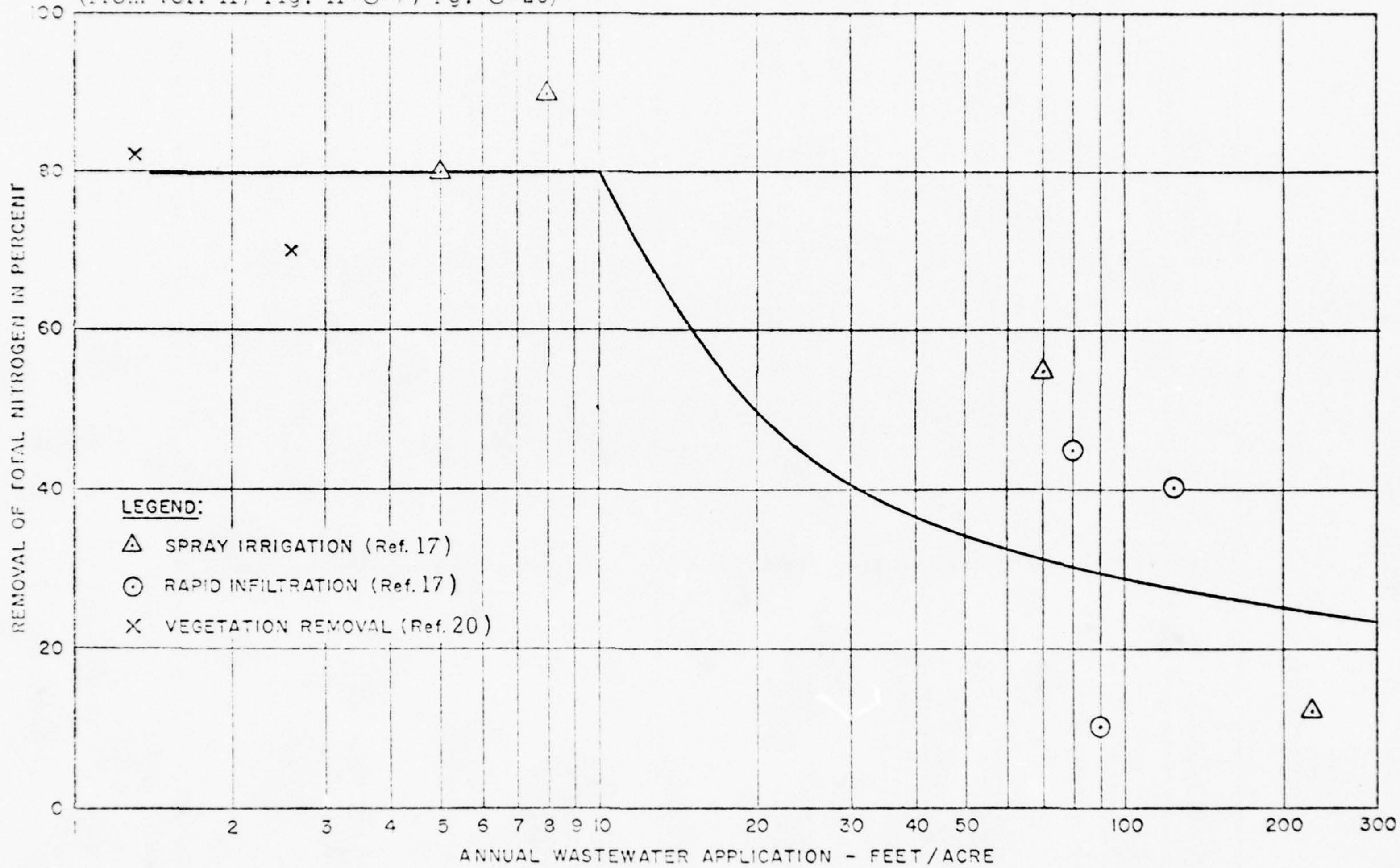

Figure V-A-9

ASSUMED NITROGEN REMOVAL RELATIONSHIP

Table V-A-9

GENERALIZED SOIL - VEGETATION RELATIONSHIPS 1/

Vegetation Types	Soil Types
Forests Redwood Monterey Pine	Gravelly to clayey soils 3 feet or more in depth and located on steep uplands and terraces with 20 to 30 percent slopes. Generally but not always Class VI, Class VII and Class VIII soils.
Pastures Rye Fescue Bermuda Clover Brome	Sandy to clayey loams 3 feet or more in depth and located on basin rims, terraces and uplands with 10 to 20 per cent slopes. May also occupy cropland soils. Generally but not always Class III, Class IV and Class VI soils.
Crops Row Truck Orchard Vines Grain Alfalfa Rice	Sandy to clayey loams 5 feet or more in depth and located in basin alluvial fans and flood plains with 0 to 10 percent slopes. Generally but not always Class I, Class II and Class III soils.
Marsh Grasses 2/ Reed Canary Grass	Sandy to silty loams 5 feet or more in depth and located in basin alluvial fans with 0-2 percent slope. Generally but not always Class I soils.

NOTES:

1/ The potential land uses for the various soil types are given in more detail in Table V-A-10.

2/ Rapid infiltration areas

(From Vol. II, Table II-C-5, Pg. C-19)

Table V-A-10

POTENTIAL VEGETATIVE COVER FOR WASTEWATER APPLICATION

Sheet 1

Site Sub-Area No.	SOIL ASSOCIATION CHARACTERISTICS: Name	Gross Area (1000 acres)	Capability Class 1/	Present Use 2/	POTENTIAL VEGETATIVE COVERS AND AREAS (1000 acres) 3/: Forest Area	Pasture Area	CROPPED AREAS: Alfalfa	Rice	Grain	Truck Field & Row	Orchard and Vines	Sugar Beets	Total Crops	Marsh Grasses	Total Net Area	Excluded Area	Maximum Unit Application (ft/yr) 4/
5.1 Capay Valley	Brentwood-Yolo	11.0	I	IC	---	---	---	---	---	---	---	---	---	10.4	10.4	0.6	90.0*
	Marvin-Rincon	0.7	II	IC	---	---	0.2	---	---	0.3	0.1	---	0.6	---	0.6	0.1	5.2
	Corning-Hillgate	0.4	IV	DC	---	0.4	---	---	---	---	---	---	---	---	0.4	---	9.5
	Dibble-Millsholm	40.0	VI	R	35.3	---	---	---	---	---	---	---	---	---	35.3	4.7	5.0*
	Positas	2.0	VII	R	---	---	---	---	---	---	---	---	---	---	---	2.0	---
	Rockland	13.0	VIII	F	---	---	---	---	---	---	---	---	---	---	---	13.0	---
Total		67.1	---	---	35.3	0.4	0.2	---	---	0.3	0.1	---	0.6	10.4	46.7	20.4	---
5.2 Hungry Hollow	Brentwood-Yolo	10.0	I	IC	---	---	---	---	---	---	---	---	---	9.5	9.5	0.5	90.0*
	Marvin-Rincon	13.0	II	DC	---	---	3.1	---	---	6.2	3.1	---	12.4	---	12.4	0.6	5.2
	Capay-Clear Lake	5.5	II	DC	---	5.3	---	---	---	---	---	---	---	---	5.3	0.2	9.5
	Pescadero-Willows	2.5	IV	DC,P	---	2.3	---	---	---	---	---	---	---	---	2.3	0.2	9.5
	Corning-Hillgate	5.5	IV	DC	---	5.2	---	---	---	---	---	---	---	---	5.2	0.3	9.5
	Sehorn-Balcolm	4.0	IV	R,DC	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	9.5
	Dibble-Millsholm	2.5	VII	R	2.3	---	---	---	---	---	---	---	---	---	2.3	0.2	5.0*
	Positas	1.7	VII	R	1.4	---	---	---	---	---	---	---	---	---	1.4	0.3	9.3
Total		44.7	---	---	3.7	16.6	3.1	---	---	6.2	3.1	---	12.4	9.5	42.2	2.5	---
5.3 Dunnigan Hills	Brentwood-Yolo	2.5	I	IC	---	---	---	---	---	---	---	---	---	2.4	2.4	0.1	90.0*
	Marvin-Rincon	8.5	II	IC	---	---	2.1	---	0.6	3.5	2.1	---	8.3	---	8.3	0.2	5.2
	Arbuckle-Cortina	2.3	III	IC,P	---	---	---	---	0.2	1.9	0.2	---	2.3	---	2.3	---	5.2
	Corning-Hillgate	11.5	IV	DC	---	11.3	---	---	---	---	---	---	---	---	11.3	0.2	9.5
	Sehorn-Balcolm	37.0	IV	DC,R	--	36.3	---	---	---	---	---	---	---	---	36.3	0.7	9.5
	Ayar-Rumsey	1.0	IV	R,DC	1.0	---	---	---	---	---	---	---	---	---	1.0	---	5.0*
	Dibble-Millsholm	15.5	VI	R	9.8	---	---	---	---	---	---	---	---	---	9.8	5.7	5.0*
	Positas	14.5	VII	R	12.8	---	---	---	---	---	---	---	---	---	12.8	1.7	10.0
	Altamont-Rumsey	6.0	VI	R	5.9	---	---	---	---	---	---	---	---	---	5.9	0.1	5.0*
Total		98.8	---	---	29.5	47.6	2.1	---	0.8	5.4	2.3	---	10.6	2.4	90.1	8.7	---
5.4 Yolo Plains	Brentwood-Yolo-Sycamore	39.7	I	IC	---	---	---	---	---	---	---	---	---	37.8	37.8	1.9	90.0*
	Marvin-Rincon-Tehama	12.5	II	IC	---	---	2.0	0.4	---	5.1	1.3	3.1	11.9	---	11.9	0.6	5.2
	Capay-Clear Lake-Sacramento	13.0	II	IC	---	---	2.1	0.4	---	5.3	1.4	3.2	12.4	---	12.4	0.6	5.2
	Harrington	5.3	II	IC	---	---	0.9	0.1	---	2.2	0.6	1.3	5.1	---	5.1	0.2	5.2
	Sacramento-Willows	3.7	III	DC	---	---	0.6	0.1	---	1.5	0.4	0.9	3.5	---	3.5	0.2	5.2
	Arbuckle-Cortina	6.2	III	IC,P	---	---	1.0	0.2	---	2.5	0.6	1.6	5.9	---	5.9	0.3	5.2
	Corning-Hillgate	5.9	IV	DC	---	5.4	---	---	---	---	---	---	---	---	5.4	0.5	9.5
Total		86.3	---	---	---	5.4	6.6	1.2	---	16.6	4.3	10.1	38.8	37.8	82.0	4.3	---
5.5 Yolo Bypass	Brentwood-Yolo	2.3	I	IC	---	---	---	---	---	---	---	---	---	2.1	2.1	0.2	90.0*
	Columbia-Sycamore	3.0	I	IC	---	---	---	---	---	---	---	---	---	2.7	2.7	0.3	90.0*
	Marvin-Rincon	0.7	II	IC,P	---	---	---	0.6	---	---	---	---	0.6	---	0.6	0.1	12.0
	Capay-Clear Lake-Sacramento	8.2	II	IC,P	---	---	1.9	3.7	1.8	---	---	---	7.4	---	7.4	0.8	9.0
	Columbia-Sandy Alluvial	1.9	III	P	---	---	---	---	---	---	---	---	---	1.7	1.7	0.2	90.0*
	Stockton-Sacramento	0.5	III	Rice	---	---	---	0.4	---	---	---	---	0.4	---	0.4	0.1	12.0
	Sycamore-Colusa	0.2	III	Rice	---	---	---	0.2	---	---	---	---	0.2	---	0.2	---	12.0
	Sycamore-Tyndall	3.3	IV	DC	---	---	0.6	---	---	2.1	0.3	---	3.0	---	3.0	0.3	5.4
	Corning-Hillgate	2.3	IV	DC	---	2.1	---	---	---	---	---	---	---	---	2.1	0.2	9.5
Total		22.4	---	---	---	2.1	2.5	4.9	1.8	2.1	0.3	---	11.6	6.5	20.2	2.2	---
5.6	Valdez-Merritt	0.6	II	IC	---	---	0.2	---	0.1	0.3	---	---	0.6	---	0.6	---	6.2
	Columbia-Lang	4.2	II,III	IC	---	---	---	---	---	---	---	---	---	4.0	4.0	0.2	90.0*

	Arbuckle-Cortina	6.2	III	IC,P	---	---	1.0	0.2	---	2.5	0.6	1.6	5.9	---	5.9	0.9	9.2
	Corning-Hillgate	5.9	IV	DC	---	5.4	---	---	---	---	---	---	---	---	5.4	0.5	9.5
Total		86.3	---	---	---	5.4	6.6	1.2	---	16.6	4.3	10.1	38.8	37.8	82.0	4.3	---
5.5 **Yolo Bypass**	Brentwood-Yolo	2.3	I	IC	---	---	---	---	---	---	---	---	---	2.1	2.1	0.2	90.0*
	Columbia-Sycamore	3.0	I	IC	---	---	---	---	---	---	---	---	---	2.7	2.7	0.3	90.0*
	Marvin-Rincon	0.7	II	IC,P	---	---	---	0.6	---	---	---	---	0.6	---	0.6	0.1	12.0
	Capay-Clear Lake-Sacramento	8.2	II	IC,P	---	---	1.9	3.7	1.8	---	---	---	7.4	---	7.4	0.8	9.0
	Columbia-Sandy Alluvial	1.9	III	P	---	---	---	---	---	---	---	---	---	1.7	1.7	0.2	90.0*
	Stockton-Sacramento	0.5	III	Rice	---	---	---	0.4	---	---	---	---	0.4	---	0.4	0.1	12.0
	Sycamore-Colusa	0.2	III	Rice	---	---	---	0.2	---	---	---	---	0.2	---	0.2	---	12.0
	Sycamore-Tyndall	3.3	IV	DC	---	---	0.6	---	---	2.1	0.3	---	3.0	---	3.0	0.3	5.4
	Corning-Hillgate	2.3	IV	DC	---	2.1	---	---	---	---	---	---	---	---	2.1	0.2	9.5
Total		22.4	---	---	---	2.1	2.5	4.9	1.8	2.1	0.3	---	11.6	6.5	20.2	2.2	---
5.6 **Sacramento**	Valdez-Merritt	0.6	II	IC	---	---	0.2	---	0.1	0.3	---	---	0.6	---	0.6	---	6.2
	Columbia-Lang	4.2	II,III	IC	---	---	---	---	---	---	---	---	---	4.0	4.0	0.2	90.0*
	Landlow-Marvin	2.0	III	Rice	---	---	---	0.9	---	0.6	0.4	---	1.9	---	1.9	0.1	8.2
	Stockton-Sacramento	18.0	III	P	---	---	4.3	---	4.3	6.4	2.1	---	17.1	---	17.1	0.9	6.3
	San Joaquin-Alamo	8.5	IV	P,Rice	---	---	---	---	---	---	---	---	---	---	---	8.5	---
Total		33.3	---	---	---	---	4.5	0.9	4.4	7.3	2.5	---	19.6	4.0	23.6	9.7	---
12.1 **Panoche**	Sorrento	1.0	I	IC	---	---	0.1	---	0.1	0.7	0.1	---	1.0	---	1.0	---	6.3
	Lost Hills	1.8	II	IC	---	---	0.2	---	0.2	1.1	0.3	---	1.8	---	1.8	---	6.3
	Pleasanton-Esparto	3.0	II	R,DC	---	---	0.3	---	0.3	1.8	0.5	---	2.9	---	2.9	0.1	6.3
	Positas	1.0	IV	R	---	---	---	---	---	---	---	---	---	---	---	1.0	---
	Los Banos	11.0	IV	R	10.8	---	---	---	---	---	---	---	---	---	10.8	0.2	10.0*
	Cibo	0.3	VII	R	---	---	---	---	---	---	---	---	---	---	---	0.3	---
	Kettleman	12.1	VII	R	---	11.9	---	---	---	---	---	---	---	---	11.9	0.2	10.2
	Kettleman	31.0	VII	R	30.1	---	---	---	---	---	---	---	---	---	30.1	0.9	13.2
	Vallecitos	26.0	VII	R	13.9	---	---	---	---	---	---	---	---	---	13.9	12.1	5.0*
Total		87.2	---	---	54.8	11.9	0.6	---	0.6	3.6	0.9	---	5.7	---	72.4	14.8	---
12.2 **Dos Palos**	Sorrento	0.7	I	IC	---	---	0.1	---	---	0.4	0.1	---	0.6	---	0.6	0.1	6.3
	Panoche	44.0	I	IC,P	---	---	4.3	---	4.3	27.6	6.4	---	42.6	---	42.6	1.4	6.3
	San Emigdio	28.0	I	IC,P	---	---	---	---	---	---	---	---	---	27.2	27.2	0.8	50.0*
	Lost Hills	31.5	I,II	IC,P	---	---	3.1	---	3.1	19.8	4.6	---	30.6	---	30.6	0.9	6.3
	Pleasanton-Esparto	0.5	II	R,IC	---	---	0.1	---	---	0.3	0.1	---	0.5	---	0.5	---	6.3
	Merced-Temple	1.0	II	IC,P	---	---	---	---	---	---	---	---	---	---	---	1.0	---
	Oxalis	32.0	III	IC,P	---	---	---	8.0	8.0	15.0	---	---	31.0	---	31.0	1.0	7.0
	Lethent	0.3	IV	IC,R	---	---	---	---	---	0.2	0.1	---	0.3	---	0.3	---	6.3
	Los Banos	0.7	IV	R	0.7	---	---	---	---	---	---	---	---	---	0.7	---	13.2
	Alluvial Land-Riverwash	0.1	VI	BA	---	---	---	---	---	---	---	---	---	0.1	0.1	---	90.0*
	Los Banos	0.8	VII	R,F	0.8	---	---	---	---	---	---	---	---	---	0.8	---	5.0*
	Kettleman	4.0	VII	R,F	0.9	---	---	---	---	---	---	---	---	---	[illegible]	3.1	10.0*
	Rough Rockland	0.3	VIII	BA	---	---	---	---	---	---	---	---	---	---	---	0.3	---
Total		143.9	---	---	2.4	---	7.6	8.0	15.4	63.3	11.3	---	105.6	27.3	135.3	8.6	---
18.1 **Sebastopol**	Pajaro	3.0	II	IC,P	---	---	---	---	---	2.6	0.3	---	2.9	---	2.9	0.1	3.5
	Clear Lake	0.6	II	IC,P	---	0.6	---	---	---	---	---	---	---	---	0.6	---	6.9
	Cotati	2.0	III	P	---	1.9	---	---	---	---	---	---	---	---	1.9	0.1	6.9
	Goldridge	9.0	IV	F,P	---	8.6	---	---	---	---	---	---	---	---	8.6	0.4	6.9
	Goldridge	0.8	VI	F,P	0.7	---	---	---	---	---	---	---	---	---	0.7	0.1	8.1
	Hugo-Laughlin-Josephine	4.0	VI	F,R,P	3.8	---	---	---	---	---	---	---	---	---	3.8	0.2	8.1
	Steinbeck-Los Osos	4.0	VI	P	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	6.9
Total		23.4	---	---	4.5	14.9	---	---	---	2.6	0.3	---	2.9	---	22.3	1.1	---
18.2 **Salmon Creek**	Pajaro	0.6	II	IC,P	---	---	---	---	---	0.5	0.1	---	0.6	---	0.6	---	3.5
	Goldridge	1.3	IV	F,P	---	1.2	---	---	---	---	---	---	---	---	1.2	0.1	7.0
	Rohnerville-Kneeland	2.5	IV	R,P	---	2.4	---	---	---	---	---	---	---	---	2.4	0.1	7.0
	Steinbeck-Los Osos	1.9	VI	P	---	1.8	---	---	---	---	---	---	---	---	1.8	0.1	5.0*
	Goldridge	6.3	VI	F,P	---	6.0	---	---	---	---	---	---	---	---	6.0	0.3	7.0
	Hugo-Laughlin-Josephine	6.1	VI	F,R,P	5.8	---	---	---	---	---	---	---	---	---	5.8	0.3	5.0*
	Yorkville-Sutherlin	1.3	VII	P,R	---	1.2	---	---	---	---	---	---	---	---	1.2	0.1	7.0
Total		20.0	---	---	5.8	12.6	---	---	---	0.5	0.1	---	0.6	---	19.0	1.0	---
18.3 **Lagunitas Creek**	Pleasanton-Zamora	1.0	II	IC	---	---	---	---	---	0.9	0.1	---	1.0	---	1.0	---	3.5
	Pajaro	3.0	II	DC,P	---	---	---	---	---	2.5	0.3	---	2.8	---	2.8	0.2	3.5
	Rohnerville-Kneeland	1.6	IV	R,P	---	1.5	---	---	---	---	---	---	---	---	1.5	0.1	6.6
	Laughlin-Parrish	3.0	VI	R,P	---	2.9	---	---	---	---	---	---	---	---	2.9	0.1	5.0*
	Los Osos	17.0	VI	P	---	16.2	---	---	---	---	---	---	---	---	16.2	0.8	5.0*
	Hugo-Josephine	5.0	VI	F	4.8	---	---	---	---	---	---	---	---	---	4.8	0.2	5.0*
	Loamy Alluvial Land	0.1	VII	R,P	---	---	---	---	---	---	---	---	---	0.1	0.1	---	90.0*
	Henneke	0.2	VII	F	---	---	---	---	---	---	---	---	---	---	---	0.2	---
	Los Gatos-Maymen	4.5	VII	R	4.3	---	---	---	---	---	---	---	---	---	4.3	0.2	7.8
Total		35.4	---	---	9.1	20.6	---	---	---	3.4	0.4	---	3.8	0.1	33.6	1.8	---
	Pajaro	12.0	II	IC,P	---	---	---	---	---	10.3	1.1	---	11.4	---	11.4	0.6	3.5
	Yolo-Cortina-Pleasanton	5.0	II	IC	---	---	---	---	---	---	---	---	---	4.8	4.8	0.2	90.0*
	Reyes	0.2	IV	DC	---	0.2	---	---	---	---	---	---	---	---	0.2	---	7.0
	Rohnerville-Kneeland	24.0	IV	P	---	22.8	---	---	---	---	---	---	---	---	22.8	1.2	7.0

Total		23.4	---	---	4.5	14.9	---	---	---	2.6	0.3	---	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18.2 Salmon Creek	Pajaro	0.6	II	IC,P	---	---	---	---	---	0.5	0.1	---	0.6	---	0.6	---	3.5
	Goldridge	1.3	IV	F,P	---	1.2	---	---	---	---	---	---	---	---	1.2	0.1	7.0
	Rohnerville-Kneeland	2.5	IV	R,P	---	2.4	---	---	---	---	---	---	---	---	2.4	0.1	7.0
	Steinbeck-Los Osos	1.9	VI	P	---	1.8	---	---	---	---	---	---	---	---	1.8	0.1	5.0*
	Goldridge	6.3	VI	F,P	---	6.0	---	---	---	---	---	---	---	---	6.0	0.3	7.0
	Hugo-Laughlin-Josephine	6.1	VI	F,R,P	5.8	---	---	---	---	---	---	---	---	---	5.8	0.3	5.0*
	Yorkville-Sutherlin	1.3	VII	P,R	---	1.2	---	---	---	---	---	---	---	---	1.2	0.1	7.0
Total		20.0	---	---	5.8	12.6	---	---	---	0.5	0.1	---	0.6	---	19.0	1.0	---
18.3 Lagunitas Creek	Pleasanton-Zamora	1.0	II	IC	---	---	---	---	---	0.9	0.1	---	1.0	---	1.0	---	3.5
	Pajaro	3.0	II	DC,P	---	---	---	---	---	2.5	0.3	---	2.8	---	2.8	0.2	3.5
	Rohnerville-Kneeland	1.6	IV	R,P	---	1.5	---	---	---	---	---	---	---	---	1.5	0.1	6.6
	Laughlin-Parrish	3.0	VI	R,P	---	2.9	---	---	---	---	---	---	---	---	2.9	0.1	5.0*
	Los Osos	17.0	VI	P	---	16.2	---	---	---	---	---	---	---	---	16.2	0.8	5.0*
	Hugo-Josephine	5.0	VI	F	4.8	---	---	---	---	---	---	---	---	---	4.8	0.2	5.0*
	Loamy Alluvial Land	0.1	VII	R,P	---	---	---	---	---	---	---	---	---	0.1	0.1	---	90.0*
	Henneke	0.2	VII	F	---	---	---	---	---	---	---	---	---	---	---	0.2	---
	Los Gatos-Maymen	4.5	VII	R	4.3	---	---	---	---	---	---	---	---	---	4.3	0.2	7.8
Total		35.4	---	---	9.1	20.6	---	---	---	3.4	0.4	---	3.8	0.1	33.6	1.8	---
18.4, .5, .6	Pajaro	12.0	II	IC,P	---	---	---	---	---	10.3	1.1	---	11.4	---	11.4	0.6	3.5
	Yolo-Cortina-Pleasanton	5.0	II	IC	---	---	---	---	---	---	---	---	---	4.8	4.8	0.2	90.0*
	Reyes	0.2	IV	DC	---	0.2	---	---	---	---	---	---	---	---	0.2	---	7.0
	Rohnerville-Kneeland	24.0	IV	P	---	22.8	---	---	---	---	---	---	---	---	22.8	1.2	7.0
	Goldridge	3.0	VI	F,P	---	2.9	---	---	---	---	---	---	---	---	2.9	0.1	7.0
	Hugo-Laughlin-Josephine	15.0	VI	F,P,R	14.2	---	---	---	---	---	---	---	---	---	14.2	0.8	5.0*
	Los Osos	20.0	VI	P	---	19.0	---	---	---	---	---	---	---	---	19.0	1.0	5.0*
	Laughlin-Parrish	1.6	VI	R,P	---	1.5	---	---	---	---	---	---	---	---	1.5	0.1	5.0*
	Steinbeck-Los Osos	28.0	VI	P	---	26.6	---	---	---	---	---	---	---	---	26.6	1.4	5.0*
	Los Gatos-Henneke-Maymen	2.2	VII	R	2.1	---	---	---	---	---	---	---	---	---	2.1	0.1	7.8
	Yorkville-Sutherlin	1.9	VII	P,R	---	1.8	---	---	---	---	---	---	---	---	1.8	0.1	7.0
	Loamy Alluvial Land	3.0	VII	R,P	---	---	---	---	---	---	---	---	---	2.9	2.9	0.1	90.0*
	Duneland	1.4	VIII	Rec	---	---	---	---	---	---	---	---	---	---	---	1.4	---
	Tidal Flats	0.1	VIII	Rec	---	---	---	---	---	---	---	---	---	---	---	0.1	---
Total		117.4	---	---	16.3	74.8	---	---	---	10.3	1.1	---	11.4	7.7	110.2	7.2	---

(From Vol. II, Table II-E-2, Pg. E-16)

3

Table V-A-10

POTENTIAL VEGETATIVE COVER FOR WASTEWATER APPLICATION

Sheet 2

Site Sub-Area No.	Name	Gross Area (1000 acres)	Capability Class 1/	Present Use 2/	Forest Area	Pasture Area	Alfalfa	Rice	Grain	Truck Field & Row	Orchard and Vines	Sugar Beets	Total Crops	Marsh Grasses	Total Net Area	Excluded Area	Maximum Unit Application (ft/yr) 4/
SOIL ASSOCIATION CHARACTERISTICS					POTENTIAL VEGETATIVE COVERS AND AREAS (1000 acres) 3/		CROPPED AREAS										
21.1 Alexander Valley	Yolo-Cortina-Pleasanton	7.0	II	IC	---	---	---	---	---	---	---	---	---	6.7	6.7	0.3	90.0*
	Goulding-Toomes	9.0	VI	R,P	---	8.0	---	---	---	---	---	---	---	---	8.0	1.0	5.0*
	Hugo-Laughlin-Josephine	6.0	VI	F,R,P	4.4	---	---	---	---	---	---	---	---	---	4.4	1.6	5.0*
	Los Gatos-Henneke	9.6	VII	R	---	7.9	---	---	---	---	---	---	---	---	7.9	1.7	6.4
	Yorkville-Sutherlin	11.0	VII	P,R	---	9.3	---	---	---	---	---	---	---	---	9.3	1.7	6.4
Total		42.6	---	---	4.4	25.2	---	---	---	---	---	---	---	6.7	36.3	6.3	---
21.2 Knight's Valley	Yolo-Cortina-Pleasanton	6.0	II	IC,P	---	---	---	---	---	---	---	---	---	5.8	5.8	0.2	90.0*
	Goulding-Toomes	5.0	VI	R	---	4.9	---	---	---	---	---	---	---	---	4.9	0.1	5.0*
	Hugo-Laughlin-Josephine	3.0	VI	R,P	2.9	---	---	---	---	---	---	---	---	---	2.9	0.1	5.0*
	Jiggs-Kidd-Rock	15.0	VII	R	11.3	---	---	---	---	---	---	---	---	---	11.3	3.7	8.1
	Los Gatos-Kenneke-Maymen	5.4	VII	R	1.8	---	---	---	---	---	---	---	---	---	1.8	3.6	8.1
	Sprekels-Felta	10.0	VII	R,P	9.7	---	---	---	---	---	---	---	---	---	9.7	0.3	8.1
	Yorkville-Sutherlin	16.0	VII	P,R	---	15.1	---	---	---	---	---	---	---	---	15.1	0.9	6.4
Total		60.4	---	---	25.7	20.0	---	---	---	---	---	---	---	5.8	51.5	8.9	---
21.3 Windsor	Yolo(overflow) Zamora	2.0	I	P,IC	---	---	---	---	---	---	---	---	---	1.9	1.9	0.1	90.0*
	Yolo-Cortina-Pleasanton	11.0	II	P,IC	---	---	---	---	---	---	---	---	---	10.2	10.2	0.8	90.0*
	Huichica-Wright	1.0	III	IC,P	---	---	0.1	---	---	0.2	0.6	---	0.9	---	0.9	0.1	4.1
	Spreckels-Felta	8.0	VII	R,P	7.4	---	---	---	---	---	---	---	---	---	7.4	0.6	8.8
Total		22.0	---	---	7.4	---	0.1	---	---	0.2	0.6	---	0.9	12.1	20.4	1.6	---
27.1 Gabilan Creek	Chualar	0.3	I		---	---	---	---	---	---	---	---	---	0.3	0.3	---	90.0*
	Farrallone	0.8	II	IC	---	---	---	---	---	---	---	---	---	0.8	0.8	---	90.0*
	Antioch-Gloria	0.3	VI	R,P	---	0.3	---	---	---	---	---	---	---	---	0.3	---	5.0*
	McCoy	3.0	VI	R	2.9	---	---	---	---	---	---	---	---	---	2.9	0.1	5.0*
	Los Gatos-Cotati	0.5	VI	R	---	0.5	---	---	---	---	---	---	---	---	0.5	---	9.6
	Arnold	4.0	VII	R	---	3.9	---	---	---	---	---	---	---	---	3.9	0.1	9.6
	Sheridan	12.4	VII	R	6.1	---	---	---	---	---	---	---	---	---	6.1	6.3	10.0
	Cieneba-Sheridan	2.0	VIII	F,Rec	---	---	---	---	---	---	---	---	---	---	---	2.0	---
Total		23.3	---	---	9.0	4.7	---	---	---	---	---	---	---	1.1	14.8	8.5	---
27.2 Quail Creek	Chualar	6.5	I		---	---	---	---	---	---	---	---	---	6.0	6.0	0.5	90.0*
	Salinas-Mocho	3.3	I	R	---	---	0.3	---	---	2.4	---	0.3	3.0	---	3.0	0.3	6.7
	Cropley	2.5	II		---	---	0.2	---	---	1.9	---	0.2	2.3	---	2.3	0.2	6.7
	Farrallone	2.5	II		---	---	---	---	---	---	---	---	---	2.3	2.3	0.2	90.0*
	Chualar	1.0	III	R	---	0.9	---	---	---	---	---	---	---	---	0.9	0.1	9.6
	Antioch-Gloria	1.5	III	P,DC	---	1.4	---	---	---	---	---	---	---	---	1.4	0.1	9.6
	Metz-Riverwash	1.7	IV	P,R	---	---	---	---	---	---	---	---	---	1.5	1.5	0.2	90.0*
	McCoy	11.5	VI	R	10.6	---	---	---	---	---	---	---	---	---	10.6	0.9	5.0*
	Antioch-Gloria	0.3	VI	R,P	---	0.3	---	---	---	---	---	---	---	---	0.3	---	5.0*
	Gloria-Placentia	1.4	VI,III	R	---	1.3	---	---	---	---	---	---	---	---	1.3	0.1	5.0*
	Sheridan	4.0	VII	R	---	---	---	---	---	---	---	---	---	---	---	4.0	---
	Vista	1.5	VII	R	---	---	---	---	---	---	---	---	---	---	---	1.5	---
	Cieneba-Sheridan	10.0	VIII	F,Rec	---	---	---	---	---	---	---	---	---	---	---	10.0	---
Total		47.7	---	---	10.6	3.9	0.5	---	---	4.3	---	0.5	5.3	9.8	29.6	18.1	---
	Chualar	8.5	I		---	---	---	---	---	---	---	---	---	8.1	8.1	0.4	90.0*
	Salinas-Mocho	5.0	I	R	---	---	0.5	---	---	3.7	---	0.5	4.7	---	4.7	0.3	6.7
	Clear Lake-Pacheco	0.1	II		---	---	0.1	---	---	---	---	---	0.1	---	0.1	0	6.7
	Cropley	0.6	II		---	---	0.1	---	---	0.4	---	0.1	0.6	---	0.6	0	6.7
	Farrallone	3.8	II		---	---	---	---	---	---	---	---	---	3.6	3.6	0.2	90.0*
	Elkhorn	0.1	III		---	0.1	---	---	---	---	---	---	---	---	0.1	0	9.6
27.3	Antioch-Gloria	1.0	III	P,DC,R	---	1.0	---	---	---	---	---	---	---	---	1.0	0	9.6

Quail Creek	Antioch-Gloria	1.5	III	P,DC	---	1.4	---	---	---	---	---	---	---	---	1.4	0.1	9.6
	Metz-Riverwash	1.7	IV	P,R	---	---	---	---	---	---	---	---	---	1.5	1.5	0.2	90.0*
	McCoy	11.5	VI	R	10.6	---	---	---	---	---	---	---	---	---	10.6	0.9	5.0*
	Antioch-Gloria	0.3	VI	R,P	---	0.3	---	---	---	---	---	---	---	---	0.3	---	5.0*
	Gloria-Placentia	1.4	VI,III	R	---	1.3	---	---	---	---	---	---	---	---	1.3	0.1	5.0*
	Sheridan	4.0	VII	R	---	---	---	---	---	---	---	---	---	---	---	4.0	---
	Vista	1.5	VII	R	---	---	---	---	---	---	---	---	---	---	---	1.5	---
	Cieneba-Sheridan	10.0	VIII	F,Rec	---	---	---	---	---	---	---	---	---	---	---	10.0	---
Total		47.7	---	---	10.6	3.9	0.5	---	---	4.3	---	0.5	5.3	9.8	29.6	18.1	---
27.3, .4, .5	Chualar	8.5	I		---	---	---	---	---	---	---	---	---	8.1	8.1	0.4	90.0*
	Salinas-Mocho	5.0	I	R	---	---	0.5	---	---	3.7	---	0.5	4.7	---	4.7	0.3	6.7
	Clear Lake-Pacheco	0.1	II		---	---	0.1	---	---	---	---	---	0.1	---	0.1	0	6.7
	Cropley	0.6	II		---	---	0.1	---	---	0.4	---	0.1	0.6	---	0.6	0	6.7
	Farrallone	3.8	II		---	---	---	---	---	---	---	---	---	3.6	3.6	0.2	90.0*
	Elkhorn	0.1	III		---	0.1	---	---	---	---	---	---	---	---	0.1	0	9.6
	Antioch-Gloria	1.0	III	P,DC,R	---	1.0	---	---	---	---	---	---	---	---	1.0	0	9.6
	Chualar	2.8	III	DC,R	---	2.6	---	---	---	---	---	---	---	---	2.6	0.2	9.6
	Placentia	6.5	III	R	---	6.2	---	---	---	---	---	---	---	---	6.2	0.3	9.6
	Metz-Riverwash	3.5	IV	P,R	---	3.3	---	---	---	---	---	---	---	---	3.3	0.2	9.6
	Gloria-Placentia	4.5	VI	R	---	4.3	---	---	---	---	---	---	---	---	4.3	0.2	5.0*
	Antioch-Gloria	7.0	VI	R,P	---	6.7	---	---	---	---	---	---	---	---	6.7	0.3	5.0*
	Arnold	11.0	VII	R,P,W	---	10.4	---	---	---	---	---	---	---	---	10.4	0.6	9.6
	Sheridan	3.5	VII	R	3.3	---	---	---	---	---	---	---	---	---	3.3	0.2	10.0
	Vista	9.0	VII	R	---	---	---	---	---	---	---	---	---	---	0	9.0	---
	Cieneba-Sheridan	3.5	VIII	F,Rec	---	---	---	---	---	---	---	---	---	---	0	3.5	---
Total		70.4	---	---	3.3	34.6	0.7	---	---	4.1	---	0.6	5.4	11.7	55.0	15.4	---
28.1 Pescadero Creek	Tunitas-Lockwood	2.5	II	P	---	---	---	---	---	2.4	---	---	2.4	---	2.4	0.1	9.2
	Watsonville-Elkhorn	0.4	III	R	---	0.4	---	---	---	---	---	---	---	---	0.4	---	5.9
	Tierra-Colma	0.5	IV	R	---	0.5	---	---	---	---	---	---	---	---	0.5	---	5.9
	Lobitos-Gazos	5.5	VI	R	5.2	---	---	---	---	---	---	---	---	---	5.2	0.3	5.0*
	Hugo-Butano-Josephine	27.3	VII	F,Rec	23.5	---	---	---	---	---	---	---	---	---	23.5	3.8	7.3
	Arnold-San Andreas	0.4	VII	R,W	---	---	---	---	---	---	---	---	---	---	---	0.4	---
	Lobitos-Gazos-Santa Lucia	0.4	VII	R,P	0.4	---	---	---	---	---	---	---	---	---	0.4	---	5.0*
	Maymen-Los Gatos	1.0	VIII	W,Rec	---	---	---	---	---	---	---	---	---	---	---	1.0	---
	Tidal Flats	0.5	VIII	non-agric	---	---	---	---	---	---	---	---	---	---	---	0.5	---
Total		38.5	---	---	29.1	0.9	---	---	---	2.4	---	---	2.4	---	32.4	6.1	---
28.2, .3	Tunitas-Lockwood	5.0	II	P	---	---	---	---	---	4.8	---	---	4.8	---	4.8	0.2	5.2
	Watsonville-Elkhorn	8.0	III	R	---	7.6	---	---	---	---	---	---	---	---	7.6	0.4	5.9
	Tierra-Colma	8.0	IV,VI	R	---	7.6	---	---	---	---	---	---	---	---	7.6	0.4	5.9
	Lobitos-Gazos	16.0	VI	R	15.2	---	---	---	---	---	---	---	---	---	15.2	0.8	5.0*
	Hugo-Butano-Josephine	32.1	VII	F,Rec	28.9	---	---	---	---	---	---	---	---	---	28.9	3.2	7.3
	Lobitos-Gazos-Santa Lucia	12.0	VII	R,P	11.4	---	---	---	---	---	---	---	---	---	11.4	0.6	5.0*
	Sweeny-Mindego	7.0	VII	R,F	6.7	---	---	---	---	---	---	---	---	---	6.7	0.3	5.0*
	Santa Lucia-Rockland	0.3	VIII	W,Rec	---	---	---	---	---	---	---	---	---	---	0	0.3	---
Total		88.4	---	---	62.2	15.2	---	---	---	4.8	---	---	4.8	0	82.2	6.2	---
42.1 Deer Valley	Brentwood-Zamora-Sorrento-Los Robles	0.5	I	IC	---	---	---	---	---	0.1	0.4	---	0.5	---	0.5	---	6.0
	Altamont-San Benito-Linne	0.3	IV	R	---	0.3	---	---	---	---	---	---	---	---	0.3	---	9.6
	Arnold	0.4	VI	R	---	---	---	---	---	---	---	---	---	0.4	0.4	---	90.0*
	Altamont-San Benito	0.8	VI	R	---	0.8	---	---	---	---	---	---	---	---	0.8	---	9.6
Total		2.0	---	---	---	1.1	---	---	---	0.1	0.4	---	0.5	0.4	2.0	---	---
42.2 Marsh Creek	Brentwood-Zamora-Sorrento-Los Robles	2.0	I	IC	---	---	---	---	---	0.4	1.5	---	1.9	---	1.9	0.1	6.0
	Altamont-San Benito-Linne	1.5	IV	R	---	1.5	---	---	---	---	---	---	---	---	1.5	---	9.6
	Altamont-San Benito	2.1	VI	R	---	2.0	---	---	---	---	---	---	---	---	2.0	0.1	9.6
	Los Gatos-Gaviota-Sobrante	2.0	VII	R	1.9	---	---	---	---	---	---	---	---	---	1.9	0.1	10.8
	Los Osos-Millsholm-Gazos	16.5	VII	R	12.1	---	---	---	---	---	---	---	---	---	12.1	4.4	5.0*
	Rockland	3.0	VIII	W	---	---	---	---	---	---	---	---	---	---	---	3.0	---
Total		27.1	---	---	14.0	3.5	---	---	---	0.4	1.5	---	1.9	---	19.4	7.7	---
42.3 Clifton Court Forebay	Cropley-Rincon	4.3	I	IC	---	---	---	---	---	0.8	3.2	---	4.0	---	4.0	0.3	6.0
	Sacramento	0.8	III		---	---	---	---	---	0.1	0.4	---	0.5	---	0.5	0.3	6.0
	Staten-Egbert	1.0	III	P	---	0.6	---	---	---	---	---	---	---	---	0.6	0.4	9.6
	Altamont-San Benito-Linne	0.1	IV	R	---	0.1	---	---	---	---	---	---	---	---	0.1	---	9.6
	Linne-Altamont	1.0	IV		---	0.9	---	---	---	---	---	---	---	---	0.9	0.1	9.6
	Altamont-San Benito	3.0	VI	R	---	2.8	---	---	---	---	---	---	---	---	2.8	0.2	9.6
	Solano-San Ysidro	2.8	IV	R	---	2.5	---	---	---	---	---	---	---	---	2.5	0.3	9.6
Total		13.0	---	---	---	6.9	---	---	---	0.9	3.6	---	4.5	---	11.4	1.6	---
42.4	Brentwood-Zamora-Sorrento-Los Robles	9.0	I	IC	---	---	---	---	---	1.7	6.9	---	8.6	---	8.6	0.4	6.0
	Cropley-Rincon	4.6	I	IC	---	---	---	---	---	0.9	3.5	---	4.4	---	4.4	0.2	6.0
	Perkins-Kimball	0.7	III	R,IC	---	---	---	---	---	0.1	0.6	---	0.7	---	0.7	0	6.0
	Altamont-San Benito-Linne	17.2	IV	R	---	16.3	---	---	---	---	---	---	---	---	16.3	0.9	9.6
	Diablo-Altamont	4.0	IV	R	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	5.0*
	Solano-San Ysidro	2.4	IV	R	---	2.3	---	---	---	---	---	---	---	---	2.3	0.1	9.6

Total		2.0															
	Brentwood-Zamora-Sorrento-Los Robles	2.0	I	IC	---	---	---	---	---	0.4	1.5	---	1.9	---	1.9	0.1	6.0
42.2 Marsh Creek	Altamont-San Benito-Linne	1.5	IV	R	---	1.5	---	---	---	---	---	---	---	---	1.5	---	9.6
	Altamont-San Benito	2.1	VI	R	---	2.0	---	---	---	---	---	---	---	---	2.0	0.1	9.6
	Los Gatos-Gaviota-Sobrante	2.0	VII	R	1.9	---	---	---	---	---	---	---	---	---	1.9	0.1	10.8
	Los Osos-Millsholm-Gazos	16.5	VII	R	12.1	---	---	---	---	---	---	---	---	---	12.1	4.4	5.0*
	Rockland	3.0	VIII	W	---	---	---	---	---	---	---	---	---	---	---	3.0	---
Total		27.1	---	---	14.0	3.5	---	---	---	0.4	1.5	---	1.9	---	19.4	7.7	---
	Cropley-Rincon	4.3	I	IC	---	---	---	---	---	0.8	3.2	---	4.0	---	4.0	0.3	6.0
	Sacramento	0.8	III		---	---	---	---	---	0.1	0.4	---	0.5	---	0.5	0.3	6.0
42.3 Clifton Court Forebay	Staten-Egbert	1.0	III	P	---	0.6	---	---	---	---	---	---	---	---	0.6	0.4	9.6
	Altamont-San Benito-Linne	0.1	IV	R	---	0.1	---	---	---	---	---	---	---	---	0.1	---	9.6
	Linne-Altamont	1.0	IV		---	0.9	---	---	---	---	---	---	---	---	0.9	0.1	9.6
	Altamont-San Benito	3.0	VI	R	---	2.8	---	---	---	---	---	---	---	---	2.8	0.2	9.6
	Solano-San Ysidro	2.8	IV	R	---	2.5	---	---	---	---	---	---	---	---	2.5	0.3	9.6
Total		13.0	---	---	---	6.9	---	---	---	0.9	3.6	---	4.5	---	11.4	1.6	---
	Brentwood-Zamora-Sorrento-Los Robles	9.0	I	IC	---	---	---	---	---	1.7	6.9	---	8.6	---	8.6	0.4	6.0
	Cropley-Rincon	4.6	I	IC	---	---	---	---	---	0.9	3.5	---	4.4	---	4.4	0.2	6.0
	Perkins-Kimball	0.7	III	R,IC	---	---	---	---	---	0.1	0.6	---	0.7	---	0.7	0	6.0
	Altamont-San Benito-Linne	17.2	IV	R	---	16.3	---	---	---	---	---	---	---	---	16.3	0.9	9.6
42.4	Diablo-Altamont	4.0	IV	R	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	5.0*
	Solano-San Ysidro	2.4	IV	R	---	2.3	---	---	---	---	---	---	---	---	2.3	0.1	9.6
	Pescadero	0.6	IV	P	---	0.6	---	---	---	---	---	---	---	---	0.6	0	5.0*
	Arnold	4.0	VI	R	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	9.6
	Altamont-San Benito	17.0	VI	R	---	16.2	---	---	---	---	---	---	---	---	16.2	0.8	9.6
	Los Osos-Millsholm-Gazos	4.0	VII	R	---	3.8	---	---	---	---	---	---	---	---	3.8	0.2	5.0*
	Los Gatos-Gaviota	0.2	VII	R	---	0.2	---	---	---	---	---	---	---	---	0.2	0	9.6
	Rockland	1.8	VIII	W	---	---	---	---	---	---	---	---	---	---	0	1.8	---
Total		65.5	---	---	0	47.0	---	---	---	2.7	11.0	---	13.7	0	60.7	4.8	---
43.1 Robert's Island	Valdez-Columbia	5.0	II	IC	---	---	---	---	---	---	---	---	---	4.6	4.6	0.4	90.0*
	Sacramento	6.0	III	IC	---	5.5	---	---	---	---	---	---	---	---	5.5	0.5	9.1
	Ryde-Egbert	14.8	III	IC	---	---	4.7	---	0.7	8.2	---	---	13.6	---	13.6	1.2	6.0
Total		25.8	---	---	---	5.5	4.7	---	0.7	8.2	---	---	13.6	4.6	23.7	2.1	---
	Valdez-Columbia	5.5	II	IC	---	---	---	---	---	---	---	---	---	5.1	5.1	0.4	90.0*
	Dinuba	0.6	III		---	0.5	---	---	---	---	---	---	---	---	0.5	0.1	9.1
43.2 Union Island	Stockton-Landlow	0.1	III		---	0.1	---	---	---	---	---	---	---	---	0.1	---	9.1
	Staten-Venice	1.0	III		---	0.9	---	---	---	---	---	---	---	---	0.9	0.1	9.1
	Sacramento	0.3	III		---	0.3	---	---	---	---	---	---	---	---	0.3	---	9.1
	Ryde-Egbert	28.7	III		---	---	4.0	---	1.3	21.1	---	---	26.4	---	26.4	2.3	5.8
Total		36.2	---	---	---	1.8	4.0	---	1.3	21.1	---	---	26.4	5.1	33.3	2.9	---

(From Vol. II, Table II-E-2, Pg. E-16)

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NOTES:

1/ Descriptions are given in Table V-A-3

2/ IF - Infiltration Area
IC - Irrigated Cropland
DC - Dry Cropland
P - Pasture
F - Forest and Timber
R - Range
Rec- Recreation
W - Wildlife
BA - Barren
EX - Excluded

3/ Based on the following priority of use of lands:
1. Marsh grasses (Reed canary grass or other grasses tolerant to prolonged soil saturation).
2. Crops (cropping pattern consistent with established practice).
3. Pasture (rye, fescue, brome, etc.).
4. Forests (Redwood and Monterey pine).

4/ Represents the maximum annual unit wastewater application rate that could be made without killing the assumed vegetative cover and is estimated as 200 percent of the site requirement of each cover plus its salt leaching requirement (see Table II-E-7). Lower unit application rates are recommended for maximum treatment of wastewater.

* Limited by the maximum soil application rate as given in Table V-A-3.

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1. The application of maximum quantities of wastewater to minimum land areas. This objective by itself would lean strongly in favor of using only the more permeable soils, a staged closed sub-surface drainage system, and a marsh grass vegetative type cover.

2. The maximization of economic crop returns from vegetative cover harvests and maximum treatment of the recovered waters. This objective would lead toward maximum development of a greater range of soils suitable for high value crops.

3. The maximum enhancement of the cultural and aesthetic values of sites by the inclusion of forest plantations in site land use pattern. This objective leans toward enchancing public acceptance and toward the production of a timber harvest which in turn contributes to total regional resources.

4. The maximum treatment of wastewaters applied to the minimum land area. This objective can be realized by cultivating pasture on all soils suitable for crops and rapid infiltration applications.

Other objectives will dictate a variety of land use patterns and wastewater application rates.

c. Proposed Site Development

General methods of wastewater distribution to land parcels will include open ditches, buried pipe laterals and combined systems. The land parcels will vary in size depending on topography, ownership, proposed land use and method of application. Spray irrigation will be used where forests, pastures and crops are involved. Areas identified as suitable for marsh grasses (high-rate infiltration areas) may be either surface or spray irrigated. Site drainage systems will incorporate open surface drains, closed sub-surface drains and wells. The choice of specific systems will depend on topography, soil and sub-soil conditions, vegetative cover, groundwater levels and water quality protection requirements. Closed sub-surface drainage systems would not be installed ordinarily until ground-water levels had risen to within about 10 feet of the ground surface. No sub-surface drainage systems would be installed in forest or pasture areas.

Development of comprehensive site systems for the conveyance, distribution, application and recovery of wastewaters must be based on

careful analysis of individual site characteristics. The specific design requirements of a particular site are primarily dictated by site topography, although many other factors are involved. The following discussion outlines a typical approach to the design of a distribution, application and recovery system for ~~Site~~ Sub-Area 5.1. This approach is not intended as a guide for the design of the conveyance, storage application and drainage systems for the site, but is rather a discussion of many of the considerations that will be involved in the design of these systems for any site. It does illustrate typical problems that will be encountered and emphasizes the need for a comprehensive and imaginative approach.

Located in the inner coast range mountains, Sub-Area 5.1 encompasses the Capay Valley in Yolo County. This valley contains both irrigated and dryland agricultural areas in the central basin, some grassland areas in the lower elevations, and hardwood forests and chaparral-mountain brush lands in the higher and steeper areas of the western and eastern ridges (see Figure V-C-1,2,3 and 4, and Figure V-A-10.) Cache Creek runs the length of the basin from north to south, from an elevation of about 440 feet at the north end to about 230 feet at the south end. The overall length of the site is approximately 16 miles, and valley width varies from about 5.5 to 7.5 miles. The gross area of the site is 67,000 acres, with 46,700 acres considered suitable for wastewater application. Included in the net area are 11,000 acres of Yolo-Brentwood soil located in the central basin area to the west of Cache Creek, which are proposed for utilization as a maximum infiltration area. The remaining area extends up the western and eastern valley slopes to maximum elevations of over 1500 feet and is suitable for forest, pasture and cropped areas.

The sub-area exhibits varied topography and soil types and illustrates the design problem of devising a system to meet the requirements of landscapes ranging from flat alluvial fans to steep forested areas. The location of Cache Creek (a California Protected Waterways Plan Class II stream) in the middle of the basin introduces the problems of locating the site systems for protection and possible enhancement of existing environmental values.

It is assumed that the potential supply of wastewater for this sub-area will be the Sacramento area, which is the nearest major metropolitan area and is approximately 40 miles southeast of the basin; thus the most probable inflow point is at the south (downstream) end of the basin. Location of the source at low point in this area introduces a typical problem of distribution system design which will be encountered in other sites. The relatively steep sideslopes along the western and eastern edges would require a pumping head of about 1000 to 1300 feet above the source point to serve the higher useable lands. The central valley portion of flat, open lands may best be served by a multiple system and/or a combination of conveyance, application

Figure V-B-1

and reclamation designs: open channels and conduits for conveyance, irrigation ditches and sprinklers for application and surface and sub-surface drains and wells for drainage.

Identification of land uses for specific areas must precede extensive design work since application requirements for rapid infiltration areas are 10 to 20 times the application requirements for forest, pasture or crop areas. It is possible that some of the potential rapid infiltration areas may be considered more valuable in other land uses; such decisions must precede design.

Consideration should be given to possible locations for wastewater storage facilities within the site in addition to any major facilities proposed for storage capacity for the site. Strategic placement of small reservoirs within the site could utilize potential natural storage areas and reduce hydraulic requirements. In addition, these facilities could be designed and operated to provide pond-settling capabilities.

Preliminary investigation of Sub-Area 5.1 indicates that there are several potential reservoir sites in the canyons along the western slope of the valley, but in-depth geologic investigations must be made to determine technical feasibility. Likewise, portions of the western and eastern slopes of the basin appear to be suitable for surface irrigation, while other areas on the slopes are too rugged to permit uniform and efficient application by surface irrigation and would require sprinkler application systems.

Any complete system proposed for Sub-Area 5.1 will have to provide for pumping of the water along the valley floor, as ground slopes along Cache Creek prevent the use of an open channel. Two basic design approaches appear to be the most feasible:

Plan 1. Pumping the water from the southern point in the basin through three separate distribution systems: one each for the eastern and western forest, pasture and crop land areas and one for the rapid-infiltration acreage located in the central valley portion.

This plan would require pumping the wastewater to the eastern and western ridges of the basin, at heights of 800 to 1200 feet above the logical southerly supply point. Additionally, a pipeline would be required for distribution of wastewater for the rapid-infiltration acreage in the central valley region. The lift for pumping to the eastern and western slopes is great, but it should be noted that flows to the eastern and western slopes comprise only about 20 to 25 percent of the total flow requirement for the basin.

A system of open channels along the eastern and western ridges could be considered in combination with gravity-fed surface irrigation systems, but site topography indicates that construction of such channels, which would be 2 to 5 times the length of the valley if natural contour elevations were followed, would be prohibitive. One alternative is the construction of pipelines along the ridges at the most feasible and convenient elevations for supplying wastewater to the irrigation and sprinkling systems at lower elevations.

With this plan, a pipeline located in the central valley floor would be required to provide wastewater to the Yolo-Brentwood rapid-infiltration area, and a series of pumping and outlet stations would be required along this central pipeline. The construction of levees in this rapid-infiltration area may permit the utilization of gravity-assisted wastewater application schemes. It should be noted that no conveyance of wastewater across Cache Creek would be required under this plan.

Plan 2. Pumping the entire quantity of wastewater through a pipeline located just upslope and to the west of the Yolo-Brentwood acreage.

An economy would be gained by pumping the wastewater through one pipeline rather than three. This system could be devised to include a minimum number of pumping stations and other costly hardware, as distribution points along the central pipeline could supply all three areas at once: the western slope, the central rapid-infiltration area, and the eastern slopes. This plan, however, must provide for conveying wastewater across Cache Creek, (see Figure V-A-10.)

With this plan, a moveable sprinkling system would be constructed to provide maximum efficiency and uniformity in the distribution of wastewater to the forest, pasture and crop areas, and spreading on the rapid-infiltration area may again be achieved by gravity-feeding to sections defined by a system of levees.

Each of the two plans for Sub-Area 5.1 calls for a central pipeline to be constructed just upslope from the the rapid infiltration area. A series of pumping and storage stations would be required at convenient locations and at suitable intervals along the pipeline. The sizes of storage and pumping facilities would be determined from application and flow requirements.

A typical sprinkler system for suitable areas might include moveable surface sub-lateral lines supplied from a network of buried main laterals receiving flow from storage and pumping stations. Areas suitable for surface

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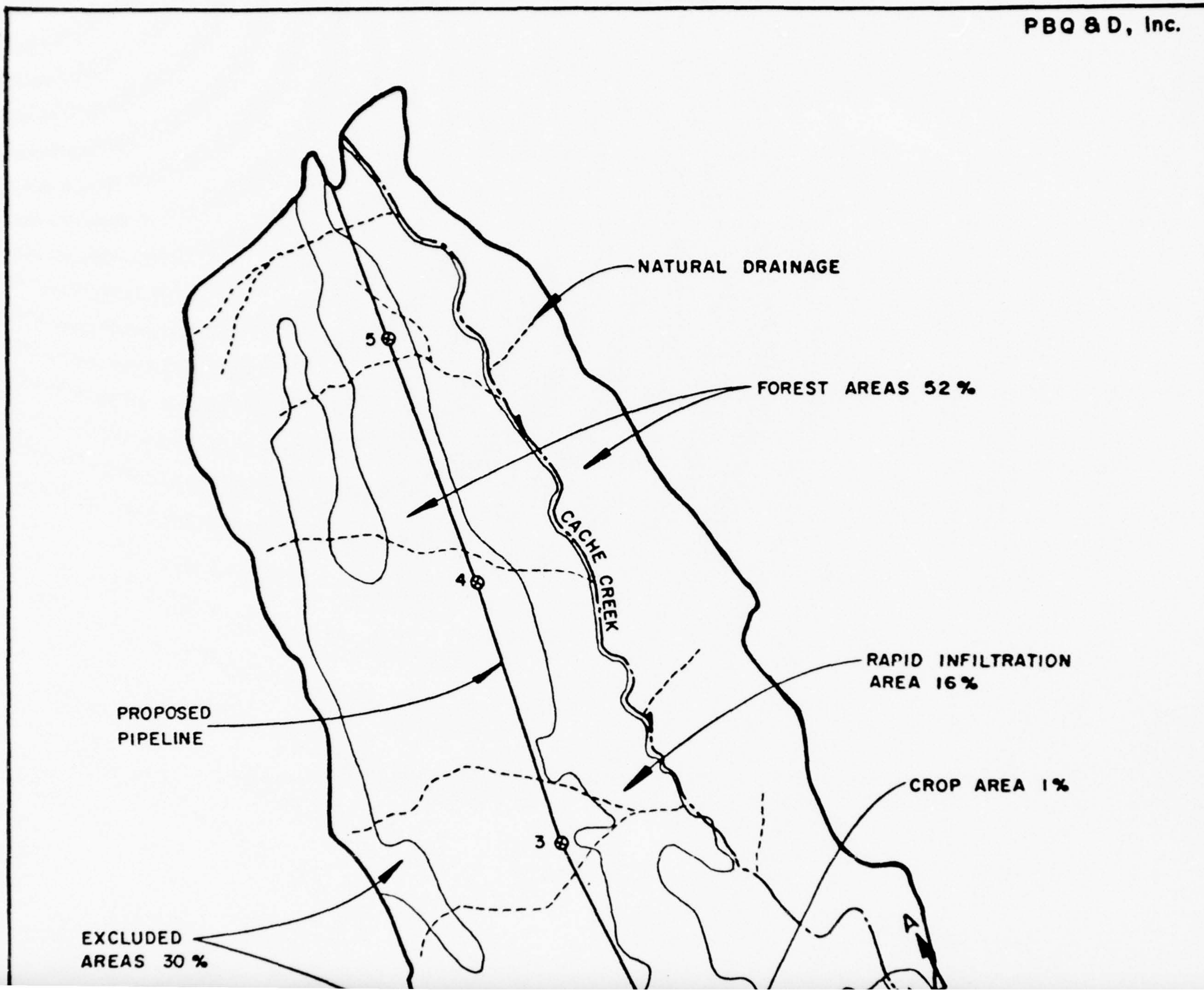

NATURAL DRAINAGE
FOREST AREAS 52%
CACHE CREEK
5
4
3
PROPOSED PIPELINE
RAPID INFILTRATION AREA 16%
CROP AREA 1%
A
EXCLUDED AREAS 30%

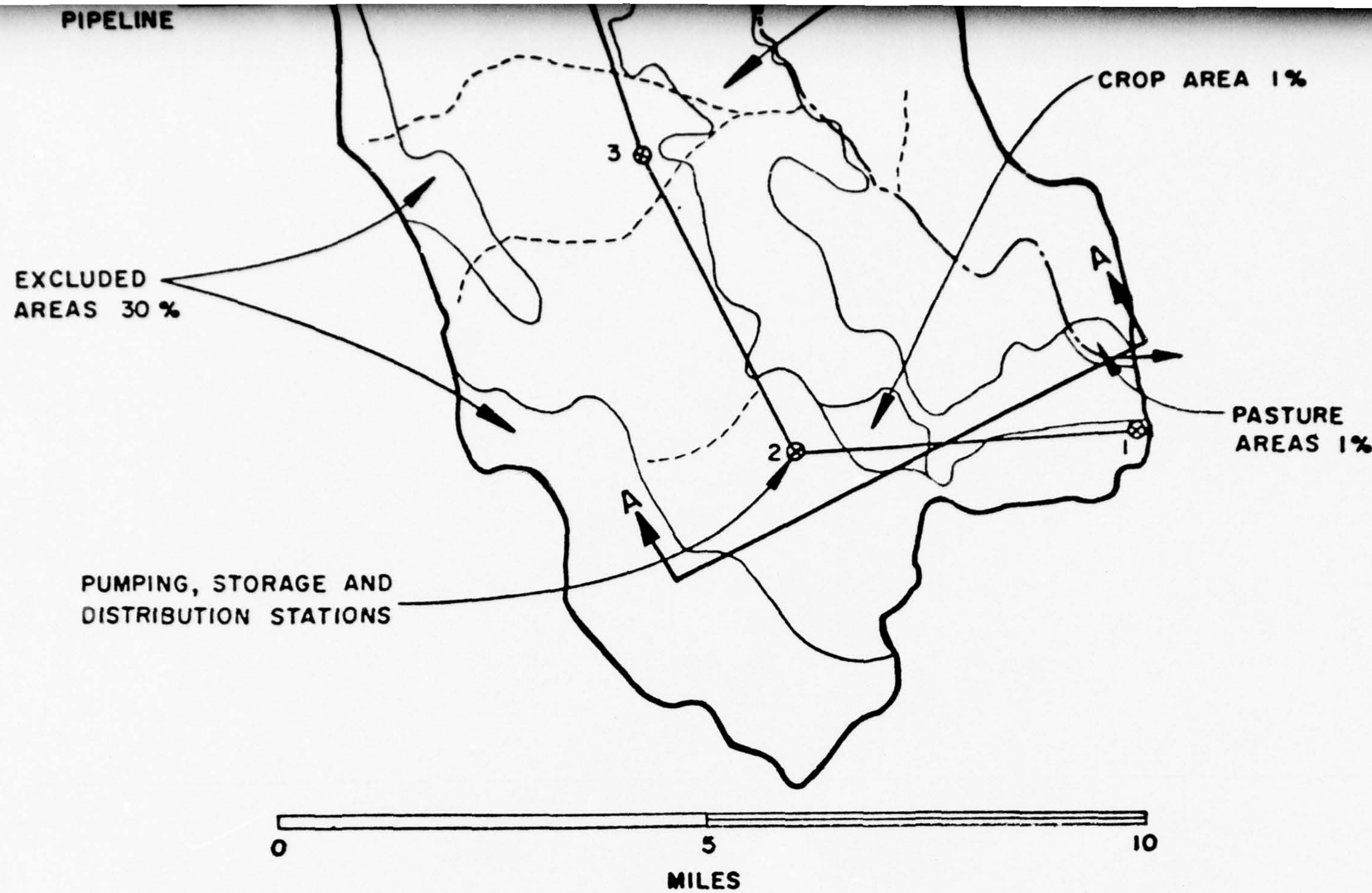


FIGURE V-A-10

TYPICAL WASTEWATER APPLICATION DEVELOPMENT

SUB-AREA 5.1 (Capay Valley)

(From Vol. II, Figure II-F-6, Pg. F-9)

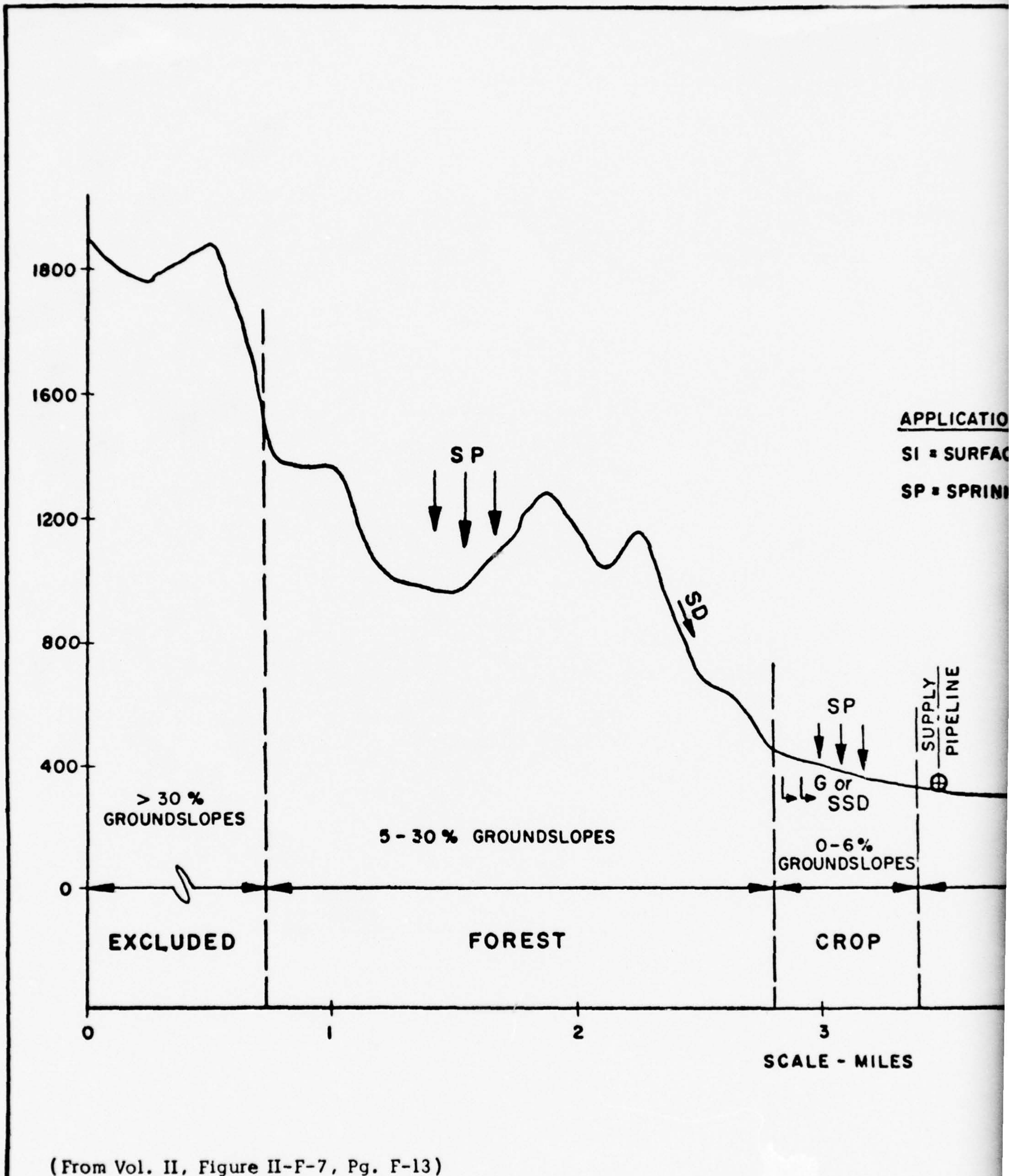
irrigation could be supplied by open ditches receiving wastewater directly from the pumping stations. The design of any application system would incorporate natural surface characteristics and slopes to facilitate ease in construction and operation. Areas with steep slopes will best be served by sprinklers (possibly utilizing mobile 3" to 6" rotating guns) and surface drainage systems, and flatter areas will more effectively utilize surface irrigation and sub-surface drainage systems. Natural drainage patterns in the sub-area are extensive and may be utilized successfully in a comprehensive recovery system.

Figures V-A-10, V-A-11 and V-A-12 show potential development for Sub-Area 5.1 and indicate potential utilizations of application and recovery systems.

d. Site Surveys and Supporting Analyses

The assessments outlined in this report resulted from investigations of the potential wastewater application sites on two levels. The first consisted of a series of reconnaissance level field surveys of the sites. Before the on-site inspection, U.S. Geological Survey maps were used to delineate major drainage basins and aerial photographs, when available, were inspected. The field surveys consisted of driving a pattern of roads for each site such that all areas or representative portions of them could be inspected. Photographs were taken of representative vistas and their locations noted. Particular attention was paid to noting the existing habitats, their extents, species and observed associated wildlife and topographic characteristics for systems development.

The second level of work consisted of an array of supporting office analyses and surveys. Aerial photographs were again inspected to fill in and verify what the field survey had indicated as to the extents of existing vegetative habitats. Impact analyses were undertaken which brought to bear knowledge of the conditions favoring and not favoring various dominant plant life in relation to the pertinent aspects of proposed land application systems development and operation with consideration of possible mitigation.



(From Vol. II, Figure II-F-7, Pg. F-13)

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FIGURE V-A-11

SECTION A - PROFILE AND POTENTIAL SYSTEMS LAYOUT

SYSTEMS

APPLICATION

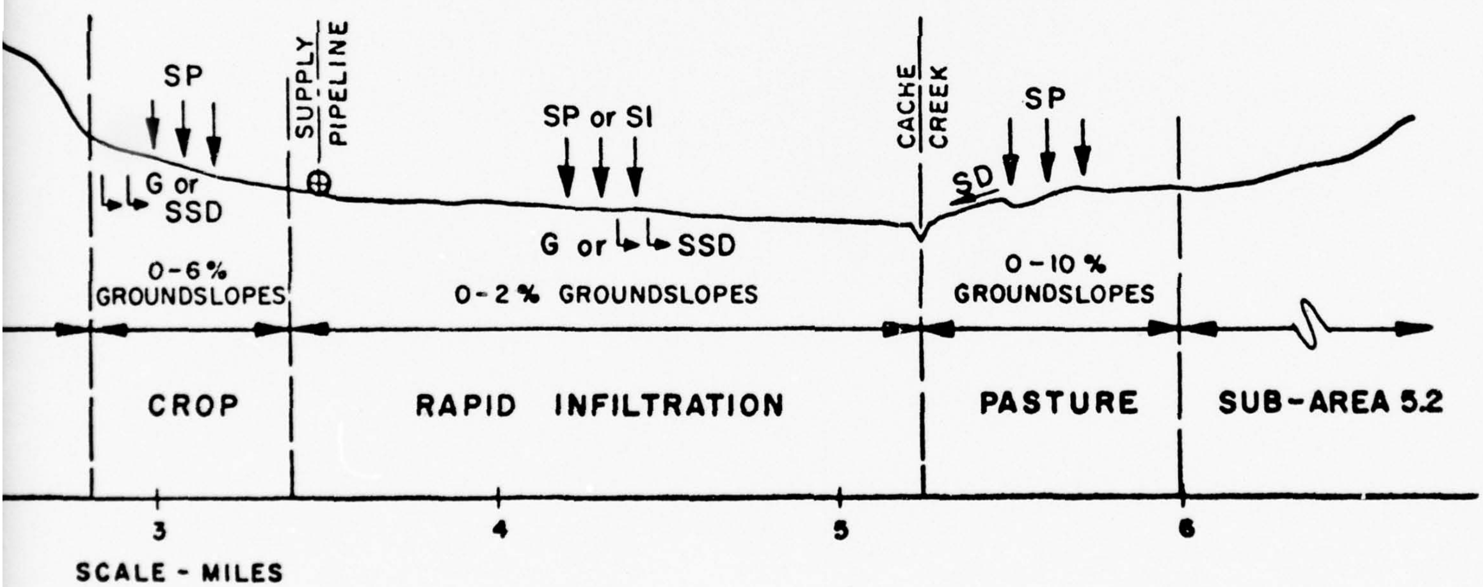
SI = SURFACE IRRIGATION

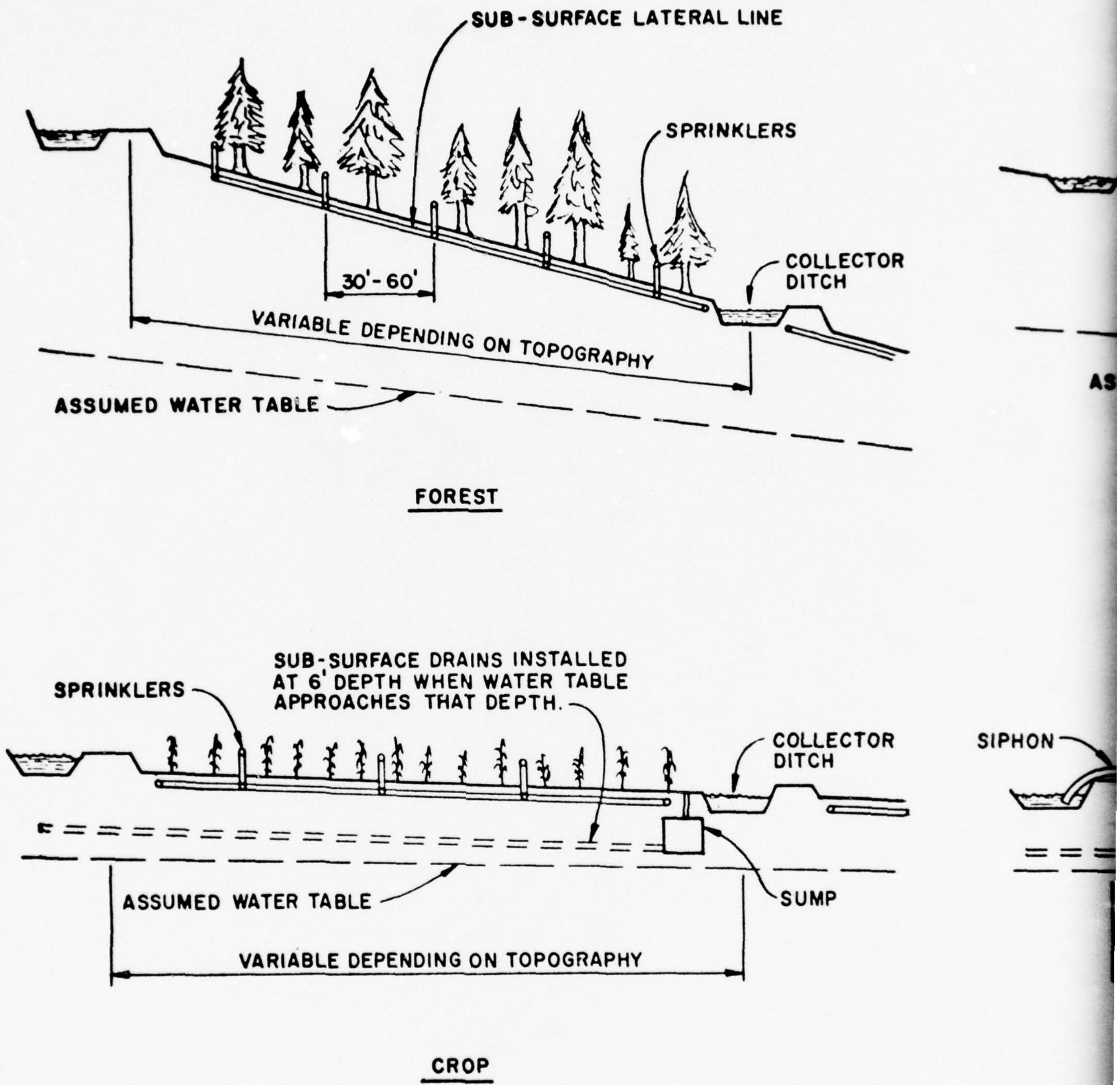
SP = SPRINKLERS

DRAINAGE

SD = SURFACE DRAINAGE

G or SSD = GROUNDWATER or SUB-SURFACE DRAINS





(From Vol. II, Figure II-P-8, Pg. F-14)

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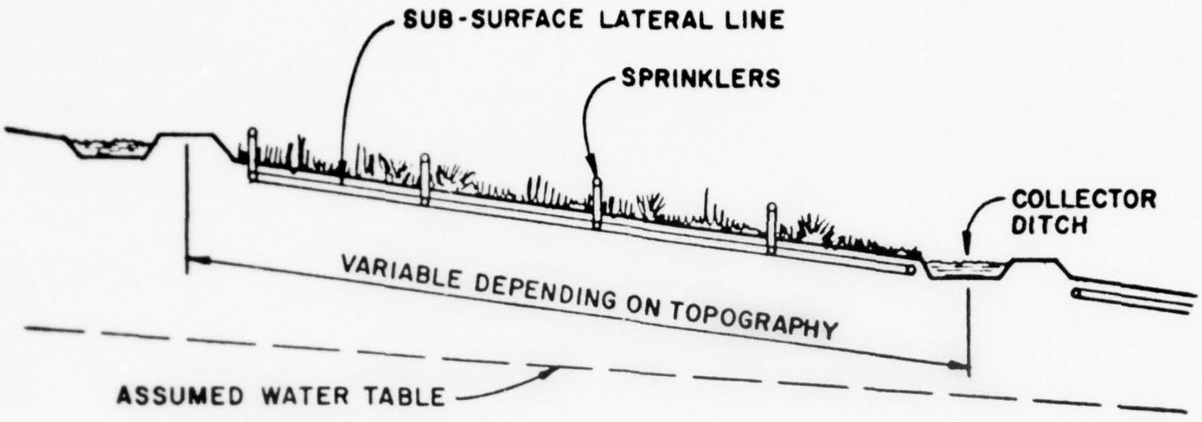
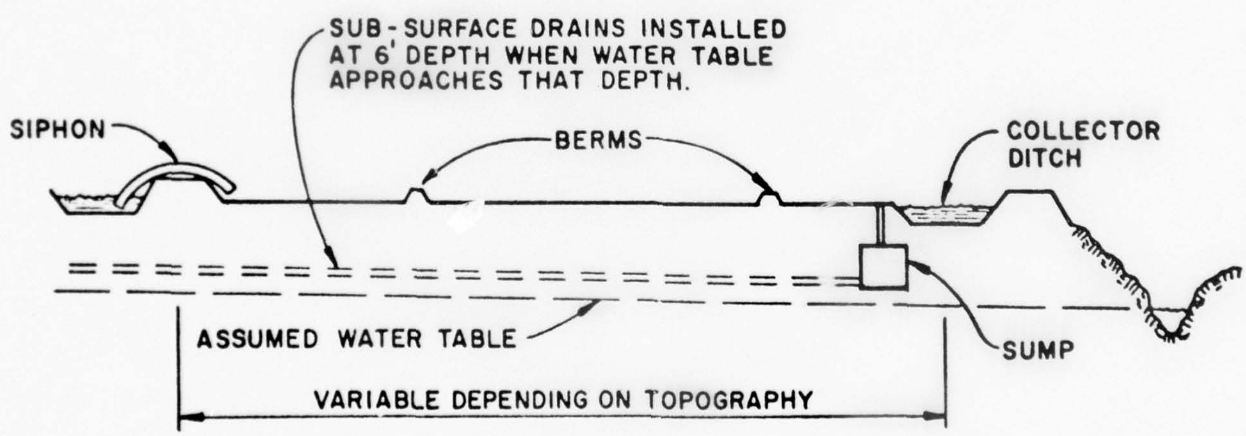


PASTURE



RAPID INFILTRATION

FIGURE V-A-12

POTENTIAL APPLICATION AND RECOVERY SYSTEM

SECTION B

B. WASTEWATER LAND APPLICATION SITE 4: GRIZZLY ISLAND WILDLIFE REFUGE AREA

1 - Project Development

a. Present Land Uses

This site is located in south central Solano County in the Suisun Marsh area. Suisun marsh lies northeast of Suisun Bay, generally east of Grizzly Bay, and immediately north of Honker Bay. Site 4 is situated about 10 miles southeast of Fairfield and 7 miles northwest of Pittsburgh. It consists of the eastern half of Grizzly Island and all of Hammond Island except a thin marshy strip lying between Grizzly Bay and a levee road connecting Roaring River Slough's levee road with Grizzly Island Road. It is bounded by Grizzly Island Road (and the remaining western half of Grizzly Island) on the northwest, Montezuma Slough all along the northern and eastern perimeter, Roaring River Slough (and Van Sickle, Wheeler, and Simmons Islands) along the southern perimeter, and the Grizzly Bay levee road previously described. Most of the Site Area lies within the California State Department of Fish and Game's Grizzly Island Wildlife Area-Grizzly Island Unit. A northwestern part around Frost Slough is owned by a private duck club.

The site occupies about 12,200 acres. All of the wildlife refuge area (except a northeastern part bounded by Montezuma Slough on the north) has been designated as sub-area 4.2. It occupies 6,600 acres. The northern marshy sub-area 4.1 occupies 5,600 acres.

The Wildlife Refuge is now managed solely as a waterfowl habitat. Through the use of tide gates, water is diverted into portions of the Site Area from Montezuma Slough in order to create and maintain marshes and ponds. Drainage is accomplished using the same tide gates and surface channels used for flooding and pumps. The pumping, however, handles a major portion of the drainage operation. The Refuge's pumps are located along the eastern perimeter of the Site Area. The principal distribution channel (and surface drain) is Grizzly Slough. The integrity of the land is maintained by a system of levees and the tide gates.

Current practice of the Refuge is to flood its ponds in a period extending from September through January, at depths necessary for the waterfowl and waterfowl hunting. The flooding operation reportedly takes about six weeks. Flooding during the spring (at lesser depths) is practiced for purposes of vegetative growth.

Current land use of Site 4 is exclusively that of duck hunting. About 1100 acres of barley are grown within the Site for attracting and feeding waterfowl. Some adjacent land owners combine cattle grazing with their duck club management.

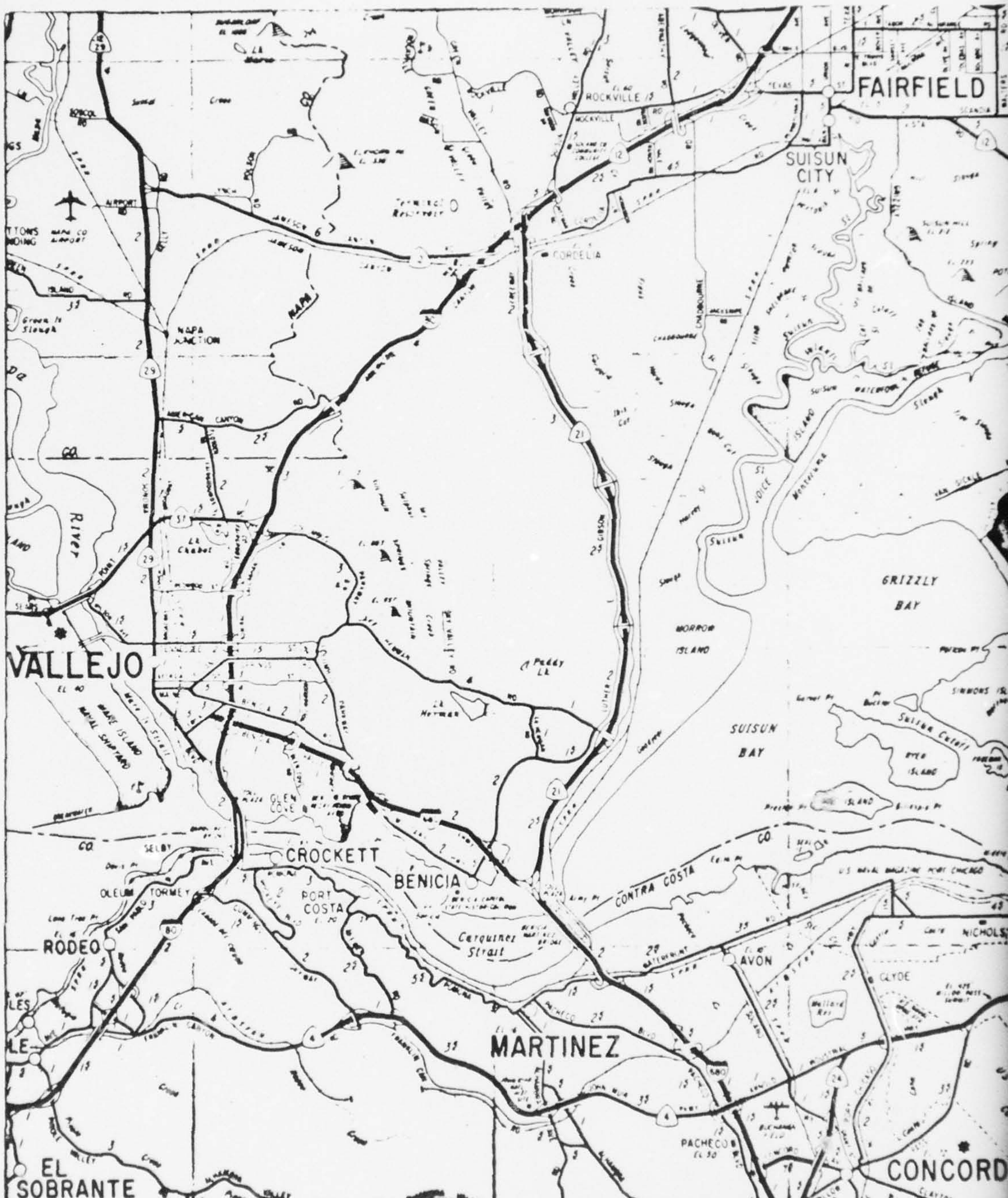
Figures V-B-1 and V-B-2 graphically show the Site Area. Figure V-A-7 shows its general location.

b. Development Objectives

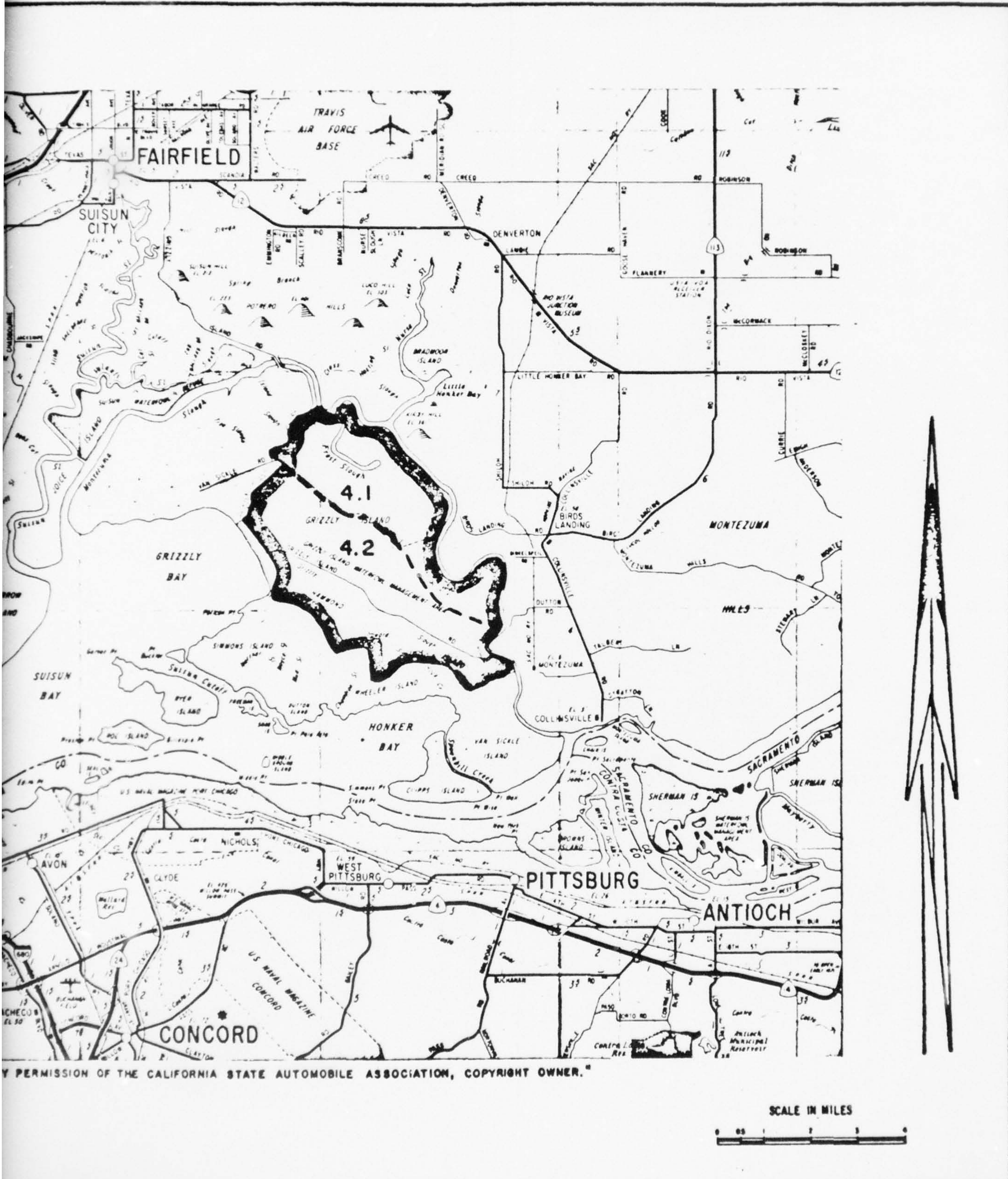
Site 4 was selected to represent the opportunity for enhancing a wildlife habitat and a recreational area and exhibits a unique potential for marshland management using wastewater to supplement or replace existing supplies. Proposed land uses and types of land application based on soil capabilities are shown in Figure V-B-3. Recommended unit application rates for these proposed and potential land uses are presented in Table V-B-1. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-B-2. Soil characteristics indicate a limited potential for agricultural applications. What cropping is proposed is for the purpose of providing food for waterfowl.

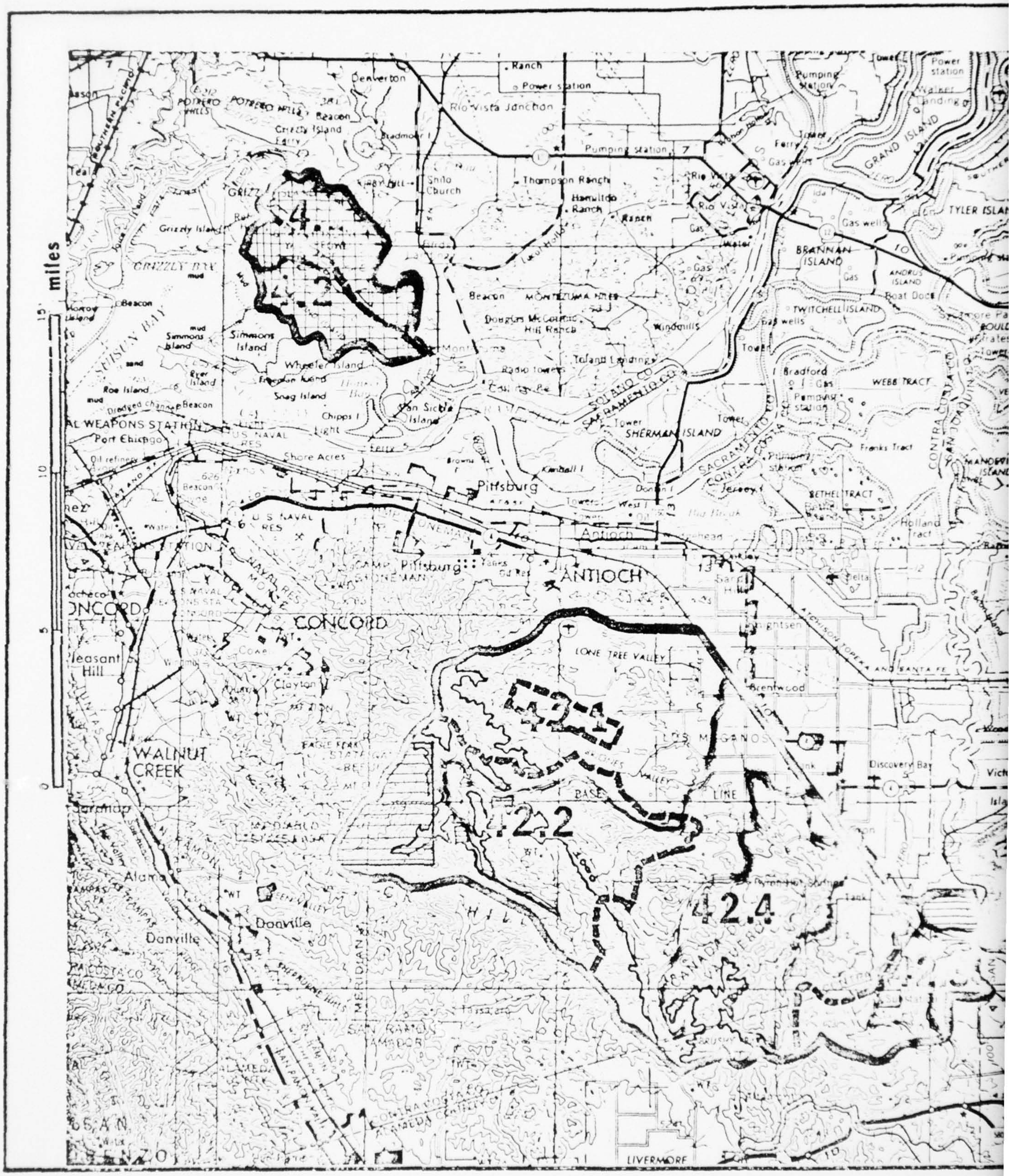
The Bureau of Reclamation has recently completed a study concerning water for irrigation for a strip of land to the east of Montezuma Slough, to provide for freshwater inflows into the slough areas behind Grizzly Island, inorder to provide a more productive natural habitat for wildlife. The Suisun Soil Conservation District has been active in the development of plans to maintain an adequate habitat for the large numbers of waterfowl that come through this area. Careful consideration should be given to the quality of any water that is applied to Site No. 4 so that it will not interfere with the growth of optimum plant foods for waterfowl and the waterfowl themselves.

Depending upon the degree of regionalization in the collection and treatment of wastewaters, the various probable sources for Site 4 could be from Fairfield-Vacaville from the north along Grizzly Road; from the small Sacramento River delta towns in the area of Rio Vista from the east with the point of input being across Montezuma Slough at the west end of Dutton Road; and from East Bay - Central and Northern Contra Costa crossing the Carquinez Straits in the vacinity of Benicia, the input point being rather uncertain. Intra-site distribution would be along the many available levee roads. This site would involve no recovery systems. The quality of applied wastewaters can be extrapolated from the data in Table V-A-5 and noting the county of the various possible sources of wastewater indicated above.



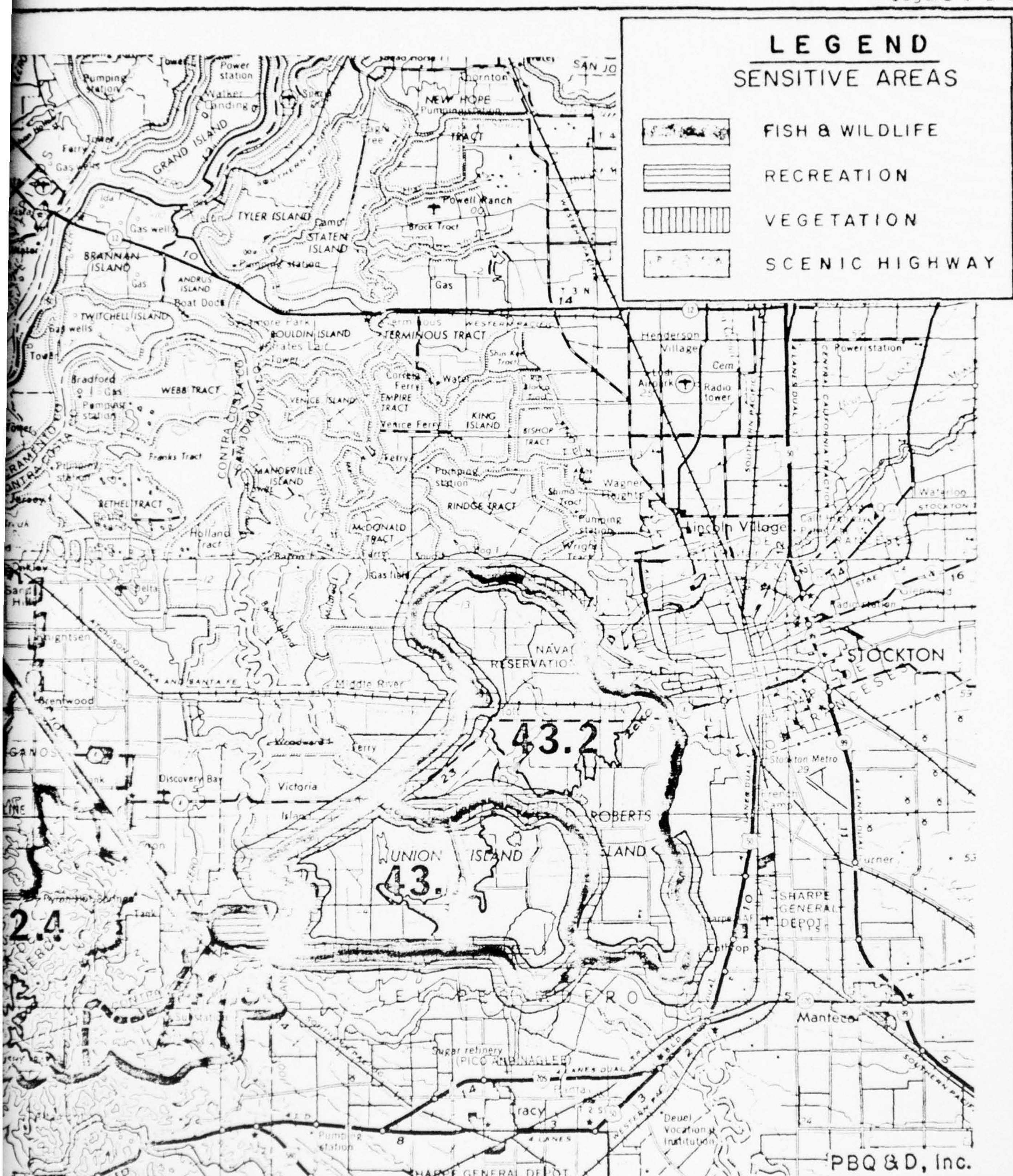
* BASIC MAP REPRODUCED BY PERMISSION OF THE CALIFORNIA STATE


TRAVIS AIR FORCE BASE
FAIRFIELD
SUISUN CITY
DENVERTON
4.1
4.2
GRIZZLY ISLAND
GRIZZLY BAY
BIRDS LANDING
MONTEZUMA
MONTEZUMA HILLS
SUISUN BAY
HONKER BAY
COLLINSVILLE
SACRAMENTO
SHERMAN IS
AVON
WEST PITTSBURG
PITTSBURG
ANTIOCH
CLYDE
CONCORD
U S NAVAL MAGAZINE CONCORD
"...Y PERMISSION OF THE CALIFORNIA STATE AUTOMOBILE ASSOCIATION, COPYRIGHT OWNER."
SCALE IN MILES



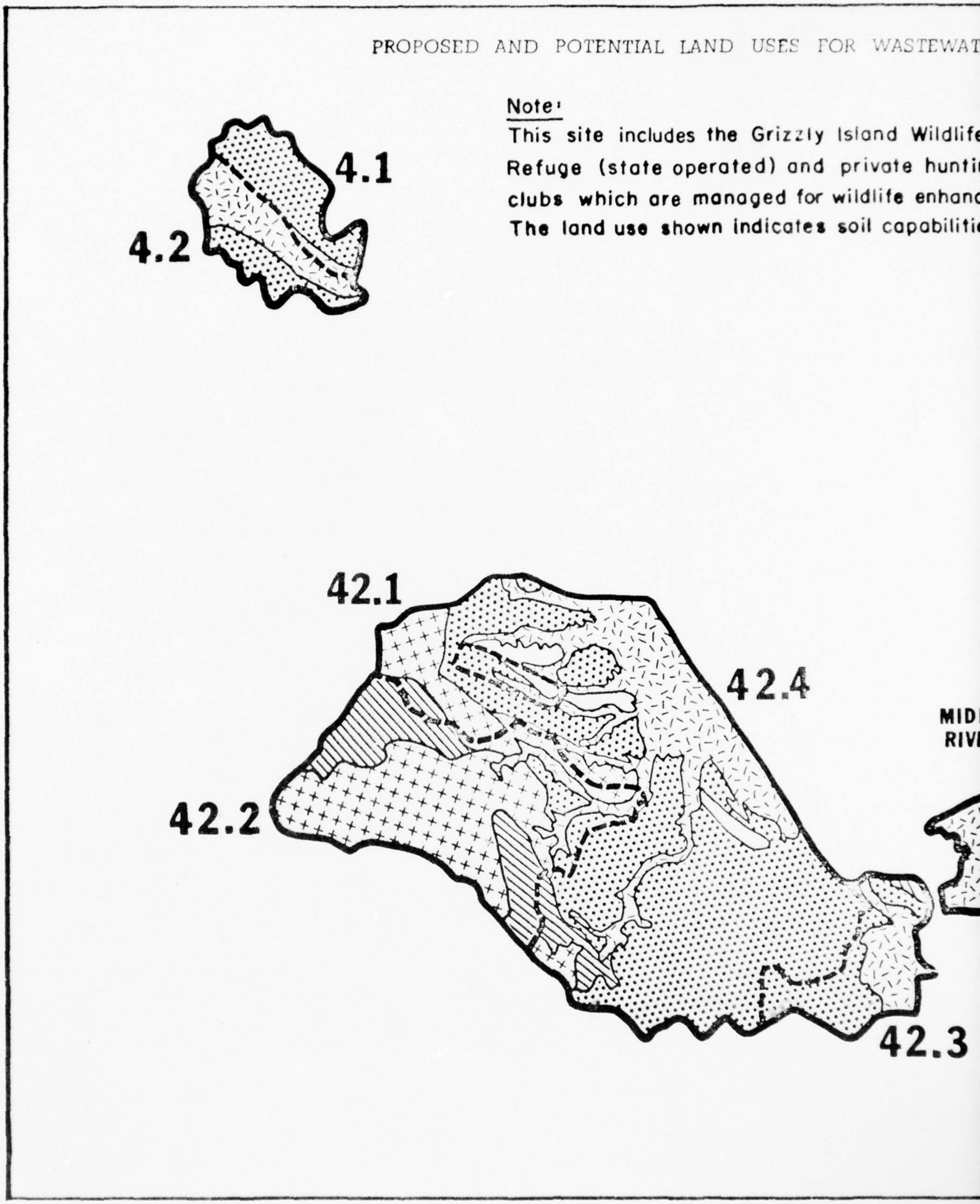
(From Vol. II, Figure II-E-1, Pg.

Figure V-B-2



m Vol. II, Figure II-E-1, Pg. E-14)

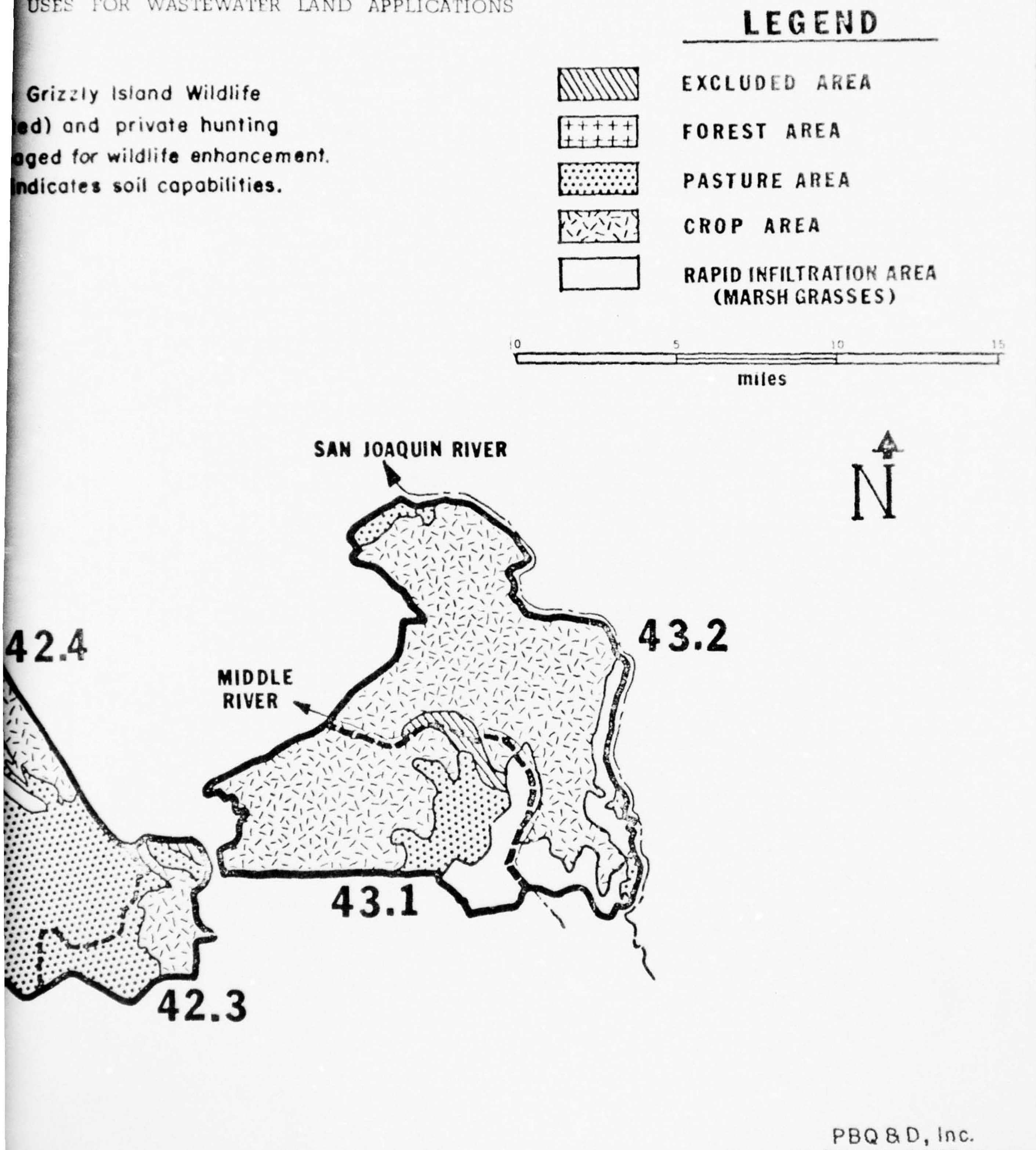
PROPOSED AND POTENTIAL LAND USES FOR WASTEWATE



(From Vol. II, Figure II-E-2,

USES FOR WASTEWATER LAND APPLICATIONS

Grizzly Island Wildlife
ed) and private hunting
aged for wildlife enhancement.
ndicates soil capabilities.



m Vol. II, Figure II-E-2, Pg. E-24)

Table V-B-1

WASTEWATER APPLICATION FOR SITE 4

Site Sub-Area No.	Waterfowl Areas		Cropped Areas		Total Net Area (1000 acres)	Total Annual Application (1000 acre feet)
	Net Area (1000 acres)	Unit Application Rate (acre-feet per acre)	Net Area (1000 acres)	Unit Application Rate (acre-feet per acre)		
4.1	5.0	5.0	0.3	6.0	5.3	26.8
4.2	2.6	4.8	3.7	3.9	6.3	26.9
Total	7.6	---	4.0	---	11.6	53.7

(From Vol. II, Table II-E-11, Pg. E-43)

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Table V-B-2

POTENTIAL VEGETATIVE COVERS FOR SITE 4

Site Sub-Area No.	SOIL ASSOCIATION CHARACTERISTICS				POTENTIAL VEGETATIVE COVERS & AREAS					Excluded Area (1000 acres)	Total Net Area (1000 acres)
	Name	Gross Area (1000 acres)	Capability Class 1/	Present Use 2/	Waterfowl Vegetation 3/	CROPPED AREAS					
						Alfalfa	Grain	Truck, Field & Row	Total Crops		
4.1	Valdez	0.4	III	DC	---	---	0.1	0.2	0.3	0.1	0.3
	Reyes-Tamba	2.0	VI	P,W	1.9	---	---	---	---	0.1	1.9
	Suisun-Joice	3.2	VI	P,W	3.1	---	---	---	---	0.1	3.1
Total		5.6	---	---	5.0	---	0.1	0.2	0.3	0.3	5.3
4.2	Valdez	3.9	III	DC	---	0.5	1.0	2.2	3.7	0.2	3.7
	Suisun-Joice	2.7	VI	P,W	2.6	---	---	---	---	0.1	2.6
Total		6.6	---	---	2.6	0.5	1.0	2.2	3.7	0.3	6.3
Grand Total		12.2	---	---	7.6	0.5	1.1	2.4	4.0	0.6	11.6

(From Vol II, Table II-E-10, Pg. E-42)

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NOTES:

1/ For definitions of capability classes, see Table V-A-3.
2/ For definitions of present uses, see Table V-A-10.
3/ Areas would be devoted to improving natural vegetation such as Alkali Bulrush.

Site 4 is considered to be located within the Coast Range geomorphic province and just beyond the western tip of the Sacramento-San Joaquin Delta, a distinctive physiographic region of the Central Valley geomorphic province.

The Site Area is characteristic of Suisun Marsh and many of the Delta islands. It is an area of alluvial deposits laced with a maze of meandering channels. With development, channelization has produced a more rigorous pattern. Elevations range from 2 feet to -3 feet, sea level being the most prevalent. Elevations along the levees range from 4 to 8 feet. There is no particular slope direction. The high elevations are in sub-area 4.2 just north of the west end of Grizzly Slough. The low elevations are in the east end of sub-area 4.1. Figure V-B-4 shows some typical views of the Site Area.

a. Geology and Hydrology

Summary of geology: The basic subsurface formations of the Site Area consist of thick accumulations of unconsolidated alluvial deposits. (Ref. 9) These are terrestrial or basin deposits of primarily sedimentary rocks of late Quaternary age; (i.e., well under one million years old, deposited between natural stream levees and fans during the flood stages of the major streams in the area). Consolidated bedrock strata lie beneath these deposits at unknown depths and are probably part of the "Franciscan basement" underlying a major part of the coast range province east of the San Andreas Fault. (See Section D-2a.) (Refs. 2,9.)

Summary of hydrologic systems and water quality conditions: The Suisun marsh is a large area of tidal flats and marshlands which has been cut into many islands by a maze of natural drainage channels. Suisun marsh is an estuarine marsh with salinities ranging from almost freshwater levels in midwinter under wet and normal outflow conditions to polyhaline levels during dry years. For reference purposes, polyhaline levels of salinity involve Total Dissolved Solids concentrations ranging between 30,000 to 18,000 mg/l, mesohaline levels between 18,000 to 5,000 mg/l TDS, oligohaline levels between 5,000 to 500 mg/l TDS, limnetic or freshwater levels being under 500 mg/l TDS. (Ref. 6.) Marine waters range between 30,000 and 40,000 mg/l TDS, 35,000 mg/l being the norm.

Site 4 lies in the eastern part of Suisun marsh, and over the Suisun-Fairfield Valley groundwater basin which is a westerly extension of the

Across Grizzley Island
E.N.E. from Grizzley Island Road

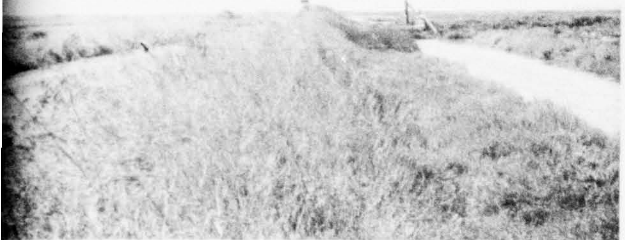
Grizzley Island Looking South Along Roarin

Mid Point of Area SW Along Roaring River Slough

N.N.E. View Across Hammond I

Off Site Panorama
Across Montezuma
Slough With Montezuma
Mountains On Horizon

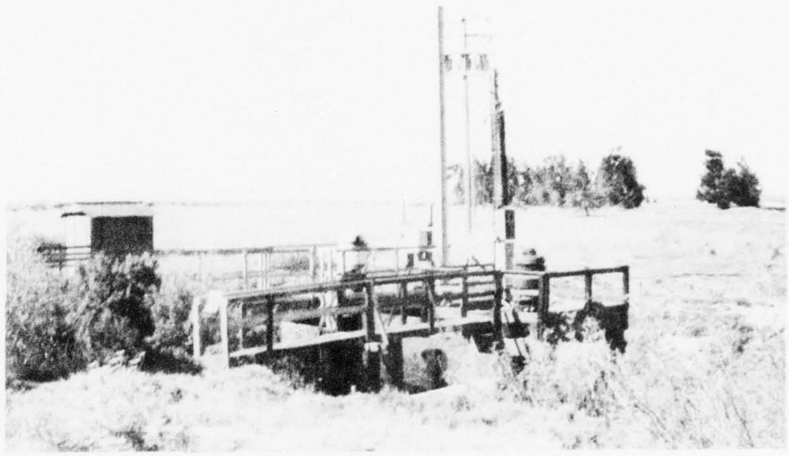
Site 4



Looking Soutn Along Roaring River Levee Road

Across Grizzley Island Marshy Area
Along Southern Montezuma Slough Levee

.E. View Across Hammond Island



Three Pumps Pulling Water Out of Two Small Sloughs
And Pumping Into Montezuma Slough

great Central Valley groundwater basin. Montezuma Slough receives freshwater from the Nurse Slough-Denverton Creek drainage to the northeast. Estimated water quality conditions for the surface water around the site and ground waters under the site are presented in Table V-B-3. Increasing salinities can be expected in the absence of firm flow commitments to the Delta and in the face of increasing diversions of Central Valley watershed waters out of the Bay-Delta system. Nutrient levels should increase significantly in the immediate future period.

b. Soils

The soils of Suisun marsh are generally peaty soils typical of areas whose natural and historical vegetative habitat is that of a Tule marsh. (Refs. 2, 10g.) The soils of Site 4 are very generally classified as non-calcic warm dry soils. The mean annual soil temperature is greater than 47 degrees F. The specific soils of Site 4 are very deep, acid, and poorly drained. The Suisun-Joice association covers 48 percent of Site 4. These soils are wet, saline, organic, and acid soils typical of marshlands. The topsoil is a black peaty or clayey muck while the subsoil is a moderately alkaline, black peaty or clayey muck which becomes very acid when drained. Combustible organic content ranges from 30 to 70 percent. The Valdez association covers 35 percent of Site 4. These soils are very deep, level, poorly drained soils of floodplains, a moderately saline stratified loamy alluvium. The topsoil is a light grey, predominantly mottled, moderately acid silty clay loam. The subsoil is a light grey, predominantly mottled silty clay, silty, and very fine sandy loam. More detailed soil information is presented in Tables V-A-2, 3, 9 and V-B-2.

c. Climatology and Meteorology

The climate of Site 4 is characterized by two distinct seasons, a warm dry one usually extending from May through October and a cool, wet season usually extending from November through April. This is modified by marine air masses and prevailing winds that come through the Carquinez Straits from the west (Refs. 2, 6, 10g, and 12.) Air temperatures average about 46°F in January and 69°F in July. Night temperatures are generally cool. Mean annual precipitation has been estimated to be 17 inches, about 80 percent falling between November through March. Mean annual evapotranspiration from non-irrigated areas is estimated to be about 15 inches. Mean annual pan evaporation has been estimated to be 65.2 inches, about 73 percent occuring between May and September. More site specific information indicates this mean annual pan evaporation may be as high as 88.5 inches. (Ref. 8)

Table V-B-3

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY SITE 4

Water Quality Characteristic	Surface Waters 1/*	Ground Waters 2/	Current Standards 2/
Total Dissolved Solids:	154-8440 mg/l 4/	250-2560 mg/l	No numerical
% time under 500 mg/l (Jan - Mar)	24%	970 median	standards
% time under 1000 mg/l (Jan - Apr)	33%		nns
% time under 2000 mg/l (Jan - Apr, early Oct)	35%		nns
% time under 3000 mg/l (Oct - late April)	58%		nns
% time under 5000 mg/l (Oct - July)	83%		nns
Electro-conductivity:	247-12,600 (in micromhos)	985-1800 1/	nns
Total hardness:	74-1386 mg/l	198-377 (319 median)	nns
Total hardness, Non-Carbonate:	11-1298 mg/l		nns
Total Nitrogen:	1.08-4.51 mg/l		nns
NO_3-N:	0.4 - 4.0		nns
Total Phosphorus:	0.05 - 0.09 mg/l		nns
Temperature - °F:	48 - 75	64-69°F 1/	nns
pH:	7.0 - 7.8	7.9 - 8.2 1/	7.0-8.5
Dissolved Oxygen:	7.5 - 10.2 mg/l		5.0 mg/l min.
BOD:	0.4 - 2.3 mg/l		nns
Suspended Sediments:	under 280 ppm 3/		nns
Ca:	13-110 mg/l		nns
Mg:	10-270		nns
Na:	34-2300 mg/l	34%-79% (45% median) (116-681 mg/l 1/)	nns
K:	3 - 96		nns
HCO_3:	76 - 106		nns
SO_4:	24 - 490		nns
CO_3:	2 - 17		nns
B:	0 - 1.4	0.3-18(1.2median)	
SiO_2:	8 - 22		nns

Table V-B-3 (continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY SITE 4

Water Quality Characteristic	Surface Waters 1/*	Ground Waters 2/	Current Standards 2/
Cl:	33-4100 mg/l 4/	26-948 (132 median)	nns
% time under 500 mg/l (Jan-Apr., early Oct.)	37%	(160-860 1/)	nns
% time under 1000 mg/l (Jan-Apr., most of Oct.)	40%		nns
% time under 2000 mg/l (Oct-Apr., most of May)	65%		nns
% time under 4000 mg/l (all except major part of Sept.)	95%		nns

1. From Hydrology Data: 1970, Vol. III: Central Coastal Area, Bulletin No. 130-70, Calif. State Dept. of Water Resources, Dec. 1971.
2. From Ref. 12, standards for surface waters only.
3. From Ref. 6.
4. Note: These values reflect water quality monitoring at the northwest corner of the Site Area. TDS, Cl, other ion concentrations will be somewhat lower along Montezuma Slough along the eastern and particularly the southeastern perimeter; they will be somewhat higher in Grizzly Bay just beyond the southwestern perimeter.

* Note: mg/l = milligrams per liter, which closely approximates parts per million (ppm.) Electro-Conductivity or Specific Conductance measures the capacity of water to convey an electric current; it is related to the total concentration of ionized substances in water and the temperature at which the measurement is made, and is therefore a way of approximating TDS concentrations, primarily inorganic TDS concentrations.
1 micromho = 0.000001 mho; 1 mho = 1/ohm.

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Mean annual potential evapotranspiration and vegetative requirements, respectively, have been estimated to be 45.6 and 36.9 inches (see Table V-A-4). The average length of the growing season is about 280 days without a killing frost. Percent humidity ranges from 71.5 percent in January to 39.0 percent in September. Clear skies predominate throughout the year. However, night and early morning fogs are common during winter. Mean annual sunshine is about 3000 to 3200 hours per year.

Summary of Air Quality Conditions: It is estimated that Site 4 currently experiences a moderately high frequency of high oxidant occurrences, approximately 20 to 40 days per year where these oxidant levels are at or about 0.10 ppm. Background discussion for this has been presented in Section A-3d. The Site Area's proximity to the developed areas of the Bay Area (the industralized Contra Costa north shore and the urbanized central Contra Costa to the south, San Francisco and Oakland to the southwest), together with the projection of current development rates would indicate a general increase in these experiences with higher oxidant levels. The degree to which current air pollution control programs, Federal, state, and local, will affect this in the immediate future period is uncertain. (Ref. 142.)

3 - Environmental Setting Without the Project: Ecological

The Suisun Marsh (54,500 acres, which includes Site 4 (11,300 acres), constitutes about 10 percent of the remaining natural wetlands in California and thus is an important wintering area in the Pacific Flyway. Waterfowl populations are estimated to include 500,000 to 750,000 ducks during the peak mid-winter period. The Suisun Marsh is a particularly critical habitat during dry years when some other marsh areas are dry or of poor quality. The permanence and stability of Suisun Marsh are derived from its particular location in the Delta. The Suisun Marsh is designated as Class I premium scenic, fishery, wildlife and recreation waterways by the California Protected Waterways Plan.

a. Vegetative Cover

One hundred and seventy-seven plant species were identified for the Suisun Marsh. Most of these species are found in low numbers and confined to levees or high ground not normally flooded. Fifteen species were identified as covering at least 1 percent of the total marsh area. These species are shown below:

Species	Approximate Percentage Covered
Salt grass (Distichlis spicata)	26
Pickleweed (Salicornia virginica)	19
Alkali bulrush (Scirpus robustus)	6
Tule (S. acutus)	5
Cattail (Typha angustifolia)	5
Brass buttons (Cotula coronopifolia)	4
Fat-hen (Atriplex patula)	4
Baltic rush (Juncus balticus)	4
Cultivated barley (Hordeum vulgare)	2
Olney bulrush (Scirpus olneyi)	2
Beard grass (Polypogon monospeliensis)	2
Cultivated oats (Avena sativa)	2
Italian ryegrass (Lolium multiforum)	1
Dock (Rumex sp.)	1
Wild radish (Raphanus sativus)	1

The species listed are of particular significance in relation to the wintering duck population. Plants selected for food by ducks were alkali bulrush, of prime importance; brass buttons, secondary in use and selection; pickleweed, third in overall use; and fat-hen, wiregrass, dock,

wild radish, silver-sheathed knotweed (Polygonum agryrocoleon), willow weed (Polygonum lapathifolium), tules and cultivated barley, which were all selected and used by waterfowl.

The distribution and abundance of the various plant species are dependent on several factors including length of time of soil submergence, depth of submergence, amounts of soil moisture and salt, soil organic matter, and marsh salinity. Of these factors, the one which has the greatest influence on the distribution of plants is the length of time of soil submergence. A secondary factor to the selection of plant species by their tolerance of submergence is the tolerance of concentration of salts in the root zone. Tolerance to submergence separates the major marsh plants into two groups: (1) plants which can tolerate longer submergence such as alkali bulrush, narrow leaf cattail, pickleweed and brass buttons which are found in the lower areas, and (2) plants such as baltic rush, salt grass and fat-hen which are not as submergence tolerant and thus are found on higher marsh areas.

A secondary factor in determining plant distribution is the soil salt concentration, particularly the soil salt concentration reached during the spring and early summer when the plants are actively growing and setting seed. For alkali bulrush, and most important waterfowl food crops (seeds are eaten), salt concentrations of less than 7,000 ppm allow the species to be outcompeted by other species, while concentrations above 24,000 ppm inhibit seed formation. For good seed production, approximately 9,000 ppm of total dissolved solids is preferred. Acceptable levels can be achieved if marsh soils remain submerged until mid-June from flooding during the previous fall. Submergence of the soil also prevents the regrowth of pickleweed, a major space competitor, until after alkali bulrush is established.

The Department of Fish and Game dry farms approximately 2,500 acres of barley on a three-year rotational program (800-850 acres per year) to attract and feed waterfowl. No crop requiring extensive irrigation can be grown in the marsh due to water salinities.

One plant species was identified as a rare or endangered species in Area 4:

Scientific Name	Common Name	Local Habitat
(Cirsium hydrophilum) var. (hydrophilum)	A thistle	Brackish marshes about Suisun Marsh

b. Fish and Wildlife

Fisheries: The Suisun Marsh has an extensive warmwater sport and non-sport fishery in Montezuma Slough. On the Grizzly Island Wildlife Refuge striped bass, catfish, and carp constitute the most abundant fish caught, although many other fish species are present.

Suisun and Honker Bays have resident marine and brackish water fish and runs of migratory fish during specific seasons. See Chapter K, the appendix, for a complete list of fish species occurring in Area 4.

Anadromous fish. Adult striped bass move through the Suisun Bay in the spring toward the Delta where they will ascend the major rivers to spawn. Juvenile and sub-adult bass also move through the Suisun Bay toward San Francisco Bay. Adult coho salmon and steelhead move through Suisun Bay in the fall and winter toward spawning grounds in the major rivers. Adult American shad also move through Suisun Bay in the spring. Anadromous fish may utilize the Montezuma Slough on their migrations:

Warmwater (freshwater) fish. Many species of warmwater game and non-game fish are found in Site 4 (Appendix, Chapter K). Salt water intrusion into the marsh in dry seasons may concentrate freshwater fish into remaining areas of freshwater. According to Mall (Ref. 65) in mid-winter under wet outflow, freshwater conditions extend almost to the western edge of the marsh. During dry years fresh water may barely reach the eastern edge of the marsh.

Marine fish. The Suisun Bay has a marine fishery. Important fish species (excluding anadromous fish) are northern anchovy, Pacific herring, Sacramento smelt, jacksmelt, white and green sturgeon, thread-fin shad, and starry flounder (species lists, Appendix, Chapter K).

Wildlife: Site 4 encompasses the total area of Grizzly Island Wildlife Area and lies within the 54,000 acre Suisun Marsh. The most notable component of the fauna is the birds, a total of 168 species, including 22 species of waterfowl which have been observed on the study area. The Site also includes 21 species of mammals (excluding bats). Most evident are the river otter, beaver, mink, muskrat, black tailed jackrabbit, striped skunk, raccoon, and salt marsh harvest mouse (Ref. 65). A listing of all wildlife species whose distribution includes Site 4 may be found in the Appendix (Chapter K).

Waterfowl. During mid-winter the peak waterfowl population varies between 500,000 and 1,300,000 ducks in the Suisun Marsh. The hunter kill of waterfowl for the Suisun Marsh from 1968 to 1971 is given below:

Table V-B-4

HUNTER WATERFOWL KILL FOR THE SUISUN MARSH FOR 1968-1971
(REF. 63)

	1968	1969	1970	1971
Duck kill	233,425	319,125	454,950	379,750
% total State kill	9.3	9.0	13.0	11.4
Goose kill	14,050	6,900	8,300	10,400
% total State kill	4.5	1.8	2.2	2.8

Table V-B-5 gives duck and geese winter population estimations from 1968 to 1971 for the Suisun Marsh and Grizzly and Joice Islands Wildlife Refuge. Population estimations of coots are listed in Table V-B-6 for 1971. Animals observed during the site survey are shown in Table V-B-7.

Rare and Endangered Species: There are 16 annual species listed as rare or endangered that occur in Site 4 - one mammal, thirteen birds, one reptile, and one fish species (see Table V-B-8). The Appendix indicates the status and designating agency for each of the rare and endangered species.

The thicktail chub occurs in the lower reaches of the Sacramento-San Joaquin River system. Little is known about its distribution or abundance. It is considered extremely rare.

The Sacramento perch was originally abundant in the sloughs and slow-flowing channels of the Sacramento-San Joquin River system, the Pajaro and Salinas Rivers, and Clear Lake. The introduction of other centrarchids (black bass and sunfish) has reduced Sacramento perch populations. Sacramento perch are poor competitors because they do not build a nest nor do they defend their eggs against predation.

The white sturgeon occurs through the Sacramento-San Joaquin Delta and Sacramento River. It is a bottom feeder, utilizing primarily certain mollusks and small crustaceans. It was once abundant throughout the Delta, but it is still common.

The Alameda striped racer occurs in most of northern and central California (Ref. 96). The east San Francisco Bay Area has been noted by the California Department of Fish and Game as habitat for the Alameda

Table V-B-5

POPULATION ESTIMATION FOR DUCKS AND GEESE FOR GRIZZLY AND JOICE ISLANDS AND THE SUISUN MARSH FROM 1968-1971 (REF. 63)

Grizzly and Joice Islands

1968 Date	1968 Ducks	1968 Geese	1969 Date	1969 Ducks	1969 Geese	1970 Date	1970 Ducks	1970 Geese	1971 Date	1971 Ducks	1971 Geese
Oct. 23	243,620	1,615	Oct. 29	658,905	705	Oct. 14	33,700	95	Oct. 13	166,615	2,009
Nov. 6	301,825	1,760	Nov. 12	437,275	1,640	Oct. 28	450,030	700	Oct. 27	306,220	2,430
Nov. 20	300,835	2,020	Nov. 26	407,720	3,400	Dec. 2	18,350	665	Nov. 10	347,240	1,795
Dec. 4	600,170	975				Dec. 9	113,325	2,275	Nov. 24	308,325	9,170
Dec. 18	527,185	1,965				Dec. 23	77,425	120	Dec. 8	499,010	30,360

Suisun Marsh

1968 Date	1968 Ducks	1968 Geese	1969 Date	1969 Ducks	1969 Geese	1970 Date	1970 Ducks	1970 Geese	1971 Date	1971 Ducks	1971 Geese
Oct. 23	9,730	- 0 -	Oct. 29	15,035	60	Oct. 14	55,605	885	Oct. 13	193,290	185
Nov. 6	9,470	- 0 -	Nov. 12	31,385	40	Oct. 28	18,925	- 0 -	Oct. 27	6,830	- 0 -
Nov. 20	25,625	85	Nov. 26	11,380	- 0 -	Dec. 2	18,310	- 0 -	Nov. 10	38,065	40
Dec. 4	2,190					Dec. 9	157,915	300	Nov. 24	60,430	3,560
Dec. 18	54,330	90							Dec. 8	43,835	40

Table V-B-6

POPULATION ESTIMATIONS FOR COOTS IN THE SUISUN MARSH AND GRIZZLY AND JOICE ISLANDS IN 1971 (REF. 63)

Dates (1971)	Grizzly and Joice Islands	Suisun Marsh
Oct. 13	8,400	6,010
Oct. 27	3,200	10,100
Nov. 10	15,550	30,100
Nov. 24	5,000	10,000
Dec. 8	15,300	19,900

Table V-B-7

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS OCTOBER 6, 1972
OF WASTEWATER LAND APPLICATION STUDY SITE 4

Birds	Mammals
Pied-billed grebe	Striped skunk
Great blue heron	Black-tail jackrabbit
White-fronted goose	
Mallard duck	**Reptiles**
Pintail	
Shoveler	Gopher snake
Greater scaup	Pacific pond turtle
Turkey vulture	
White-tailed kite	
Red-tailed hawk	
Marsh hawk	
American kestrel	
Ring-necked pheasant	
Killdeer	
Mourning dove	
Burrowing owl	
Red-shafted flicker	
Bank swallow	
Mockingbird	
Robin	
Loggerhead shrike	
Western meadowlark	
Red-winged blackbird	
Brewer's blackbird	
House finch	
Rufous-crowned sparrow	
Whimbrel	
Brown towhee	
Gull, juvenile	

Table V-B-8

RARE AND ENDANGERED SPECIES OF SITE 4

Common Name	Status	Occurrence on Site 4
Fish		
Thicktail chub	U	x
Sacramento perch	U	x
White sturgeon	U	x
Reptiles		
Alameda striped racer	R	x
Birds		
Aleutian Canada goose	E	*
Tule white-fronted goose	U	*
Red-bellied red shouldered hawk	U	*
Ferruginous hawk	U	x
Southern bald eagle	E	*
American osprey	U	x
Prairie falcon	R	x
American peregrine falcon	E	x
California black rail	R	x
Alaskan short-billed dowitcher	U	*
Yukutat fox sparrow	U	*
Samuel's song sparrow	U	*
Suisun song sparrow	U	x
Mammals		
Salt marsh harvest mouse	E, U	x

E Endangered

R Rare

U Status uncertain

x This species or subspecies definitely or probably occurs on the wastewater application site.

* Occurrence of this species or subspecies in the wastewater application site is uncertain or questionable and limits of discussion poorly documented.

striped racer. It is usually associated with chaparral, but may be found in open woodland and grassland.

The raptorial bird species (birds of prey) listed as rare or endangered all face similar problems of survival. All of them are at the end of food chains and thus are accumulating serious concentrations of pesticides. Shooting by irresponsible people and encroachment on nesting and feeding areas has also reduced the numbers of the southern bald eagle, ferruginous hawk, and the red-bellied red-shouldered hawk. The American peregrine falcon has been illegally taken by falconers.

The status of California black rail is not presently known. It inhabits salt marshes and is only rarely sighted. It once occurred in limited numbers in salt marshes from Tomales Bay south to Baja, California. The California black rail's current distribution and numbers are undetermined.

The Alaskan short billed dowitcher is a winter visitor to central California. It inhabits marshes, mudflats, and open water, especially salt water. Mudflats and salt marshes are critical habitat, providing food and cover for the birds.

The salt marsh harvest mouse formerly inhabited the extensive marshes bordering San Francisco Bay. Now, because of continued diking and filling of marshes, the habitat has diminished to the remaining salt marsh areas.

<u>Wildlife and Fish Diseases</u>:

<u>Wildlife Disease</u>. Wildlife disease studies reviewed for the past 30 years have disclosed a history of significant importance. There are three conditions endemic on Site 4 which must be considered in light of the proposed wastewater applications. The effect of these conditions is on waterfowl primarily and on pheasants secondarily. The disease conditions are avian cholera, botulism and lead poisoning.

Avian cholera has occurred intermittently on Grizzly Island. This wildlife disease mostly affects waterfowl, but during severe outbreaks a wide variety of birds such as gulls, herons, owls, sandhill cranes, shorebirds and others also die (Ref. 108a). The causative organism is a bacterial species, <u>Pasteurella multocida</u>. Dead waterfowl contaminate water with nasal secretions which contain millions of pathogenic bacteria that remain viable for at least three weeks. The infectious water is either ingested or inhaled as a spray aerosol, and geese, swans or ducks contract the disease which is so acute that they succumb within 12 to 24 hours. Outbreaks of avian cholera are explosive in nature so that usually there is a sudden appearance of hundreds of dead waterfowl.

There is a seasonal incidence of avian cholera which usually appears sometime between the third week of December and the second week of January. Waterfowl losses continue until April at which time the northern migration is well underway.

During the decase of the 1950's avian cholera occurred annually at Grizzly Island. A change in water management in 1960 effectively terminated further outbreaks with a few exceptions. For example, in 1966 when 70,000 waterfowl died of avian cholera throughout northern California only about 300 birds died on some gun clubs at Grizzly Island north of wildlife area. The effective water management change was drainage of the ponds immediately following the hunting season. As a result, the heavy concentrations of waterfowl were dispersed to other areas. Since the mortality is considered to be a localized density-dependent situation, drainage of selective areas with subsequent dispersal of large flocks has a beneficial effect. This concept has been demonstrated on the Grizzly Island Wildlife Management Area. If the proposed discharge of wastewater should prevent drainage of ponds, the situation could revert to that of the 1950's when avian cholera was an annual event and could result in the deaths of hundreds of waterfowl.

Another method of prevention or control of avian cholera is through effective water application. Since transmission via water containing infectious bacteria which can remain viable for as long as three weeks, contaminated ponds could be flushed out and dilution would decrease the opportunity for further infection. This action would be most applicable to Area 4 as further dilution could be accomplished by the discharge of water into Montezuma Slough.

Avian botulism has occurred on rare occasions at Grizzly Island. This disease is caused by a toxin formed by the anaerobic bacterial species Clostridium botulinum Type C. Botulism has a profound impact on the population dynamics of waterfowl because it has the potential of killing millions of waterfowl in some years in the western states. Ducks, coots and shorebirds develop botulism by the ingestion of aquatic invertebrates or maggots which contain the toxin. Other sources of botulism are unknown at present, but it is recognized that warm temperatures and anaerobic conditions resulting from a high biochemical oxygen demand in decomposing organic matter contribute to the appearance of botulism. Shallow standing water is a factor associated with causation of the disease (Ref. 108b).

Algal blooms are important contributing causes of botulism because these plants provide nutrition for aquatic invertebrates which eventually undergo a logarithmic death phase and the resultant animal remains become

individual lethal packets containing the toxin of botulism. The dead aquatic invertebrates are avidly eaten by waterfowl. The algae create a high biochemical oxygen demand during endogenous metabolism and additionally after death of the plants the oxygen depletion of the water is increased by bacterial decomposition in the anaerobic environment.

High levels of wastewater applied to Site 4 during the summer could result in botulism if some flooded areas contained "standing" water. The threat of botulism could be avoided by continuous flow or circulation of water and maintenance of depths at 18 or more inches on all areas consistent with the waterfowl food plant requirements. The ponds must be constructed on contours to permit continual flow from one unit to another with a final discharge into Montezuma Slough. Positive control on water distribution is a technique which cannot control botulism but could prevent it.

Lead poisoning is not an infrequent condition among waterfowl and pheasants at Site 4. The birds die as a result of the ingestion of spent lead shot on the hunting areas (Ref. 109 and 110). Generally after the hunting season when the water is drained, the birds take in the lead pellets in lieu of grit for their gizzards. The application of large amounts of water to continually flush the ponds, as indicated under avian cholera control, could have a beneficial effect in the prevention of lead poisoning.

No other wildlife diseases have been significant on Area 4, and there is no reason to believe that the application of wastewater which has undergone secondary treatment, if managed according to the principles outlined above, could be responsible for the appearance of any new diseases in wildlife. This wastewater would have a beneficial impact.

Fish Diseases and Parasites. In Site 4, marine fish, freshwater fish, and anadromous fish occur in the area or closely adjacent to it. The diseases and parasites that occur with these fish are more or less common to the fish found on all of the wastewater management areas. Fish, as other animals, have their compliment of diseases and parasites. The great majority of fish diseases are caused by either bacteria or protozoa. Other ailments are caused by water fungi (Saprolegniaceae), viruses, nematode worms, various flukes and copepods. Rising water temperatures and receding water levels that crowd fish together tend to promote growth, and spread some fish diseases and parasites. Fish in poor physical condition or under stress are more susceptible to disease and parasites than are healthy fish.

At the present time there seems to be no direct relationship between the increased incidence of fish parasites and diseases in secondary treated

sewage water (Ref. 120). Fish diseases and parasites usually are not detrimental to the population as a whole, except in crowded hatchery (unnatural) conditions.

Parasites such as nematodes, cestodes, and trematodes require intermediate hosts (snails, molluscs, copepods) before the parasite can be transferred to fish. Therefore, an increase in the intermediate host could cause an increase in the parasite incidence among fish.

1. Bacterial diseases. Furunculosis, caused by Aeromonas salmonicida, affects chiefly salmonids. The bacterium grows best at low temperatures (50-60°F) and is transmitted through wounds, in the body or gills, or through the intestinal wall. The disease is thought to be endemic to Pacific salmon and rainbow trout and outbreaks may occur when the vitality of the fish is lowered.

Bacterial hemorrhagic septicemia or ulcer disease (Aeromonas liquefacieus) is a world-wide disease of freshwater cultured and wild fish.

Columnaris disease and gill disease are two of the important Myxobacterial fish diseases. Stress caused by environmental conditions may trigger these diseases in fish. Columnaris disease may be caused by crowded conditions and high temperatures (77 to 88°F), especially in juvenile fish. At temperatures below 60°F, the disease seldom injures fish.

Corynebacterial kidney diseases are found in freshwater fish, especially trout. The disease is thought to be transferred by infected fish.

2. Protozoan diseases. All major groups in the protozoa have representatives as fish parasites. Some of the important ones will be mentioned here.

"Ich" (Ichthyophthirus sp.) is a common external protozoan disease of warmwater fish and trout (crowded conditions). Catfish, carp and sunfish are especially susceptible to "Ich". The cysts (multiplication stage) of "Ich" are usually found on the bottom of waterways, but they may be found on the surface in standing water. From the cyst the young parasites look for a host. Crowded conditions will increase the incidence of this disease.

Costiasis or "blue slime" (Costia sp.) is an important external protozoan disease. Costia necatrix is the most destructive of the ecto-parasitic protozoans on trout and salmon and it also occurs on a wide variety of warmwater fish. Costiasis can be spread by contact and may result in severe attacks especially under crowded or stress conditions.

Trichodiniasis (Trichodina sp.) is the most common external parasite of freshwater fish. The parasites are spread by direct contact so that crowding fish could result in an increased incidence of the parasite among fish. Cool water temperatures (40°F) allow the parasite more time (140 hours) to remain on a dead host fish.

Octomitiasis is a common intestinal fish parasite, especially in young salmonids. Two forms of octomitiaris (Octomitus sp.) occur; a chronic form that results in severe emaciation of trout fingerlings and an acute infectious form that occur sporadically, usually in early season and results in heavy mortalities. Trout longer than 3 to 4 inches are usually immune even though they may harbor large numbers of these organisms. Many parameters may affect development of Octomitus; among those are deficiency in dissolved oxygen, crowded conditions and malnutrition.

Cryptobia is a protozoan found in the blood and visceral cavity of salmonids of western North America.

"Whirling disease" caused by Myxosoma cerebralis is a serious disease of salmonids, especially juvenile fish. It attacks and destroys cartilage of young fish; but it requires a long time to develop before it is noticeable. Since its introduction from Europe, it has spread rapidly into the United States and has recently occurred in California among salmon in a central California coastal stream (Ref. 120).

3. Virus diseases. The most important virus disease on the west coast is Sacramento River or chinook virus (SRCD). It is endemic to California among chinook salmon populations and causes heavy salmon losses.

Infectious pancreatic necrosis (IPN) infects young salmonids, especially in hatchery conditions. It is considered highly contagious.

4. Water fungi. (Saprolegnia sp.) Saprolegnia is a secondary infection often found on injured fish. It may continue to grow eventually killing the fish. This fungi may infect dead fish eggs and spread to adjacent healthy eggs, killing them.

Another fungal disease is Ichthyosporidium hoferi which causes systemic infections in marine fish. However, recently it has been recognized as a pathogen of warmwater fish in ponds.

5. Trematode (flat worms). These parasites are often called "flukes". Gyrodactylus is an important external parasitic fluke of fish. In some species the entire life cycle is spent on the host. In general, parasites that have a close relationship with the host species do not cause considerable damage to the host. But, a fish under stress or a weakened condition may be killed by external parasites, particularly if the parasite load is unusually heavy.

The "blood fluke" (Sanguinicola sp.) does serious damage to the gills of freshwater fish during the fluke's larval stage when they burrow out of the gills.

The yellow grub (Clinostomum marginatum) is a digenetic trematode of warmwater fish. The cercaria (free-swimming stage) infect the fish and encyst in the tissues. At normal parasite loads this apparently causes little damage to fish; however, a heavy parasite load may cause emaciation of the fish. Aquatic snails serve as intermediate hosts for this parasite, and an increase in the snail intermediate host could increase the presence of the parasite in fish.

6. Tapeworms and Roundworms. The bass tapeworms (Protecocephalus ambloplitis) is a cestode parasite of warmwater fish, especially centrarchids (sunfish) in which the adult worm infects bass. The tapeworm eggs develop in copepods (microscopic invertebrates) which are eaten by small fish which in turn are eaten by bass, when the adult tapeworm remains. Bass with heavy tapeworm loads may be sterilized because of damage to the gonads. An increase in the species of copepods (aquatic) that carry the eggs could increase the tapeworm infection.

The nematode parasite, the red-round worm (Eustrongylides sp.) is very common among centrarchid fish (sunfish and black bass). The larval stage encysts in the tissue of fish, frequently making the fish unfit to eat. The life cycle of this parasite is not well understood, except that adult worms remain in the oral cavity of some fish eating birds (herons and egrets).

7. Leeches. They occasionally attack fish and leave wounds open for secondary bacterial or fungal infections.

8. Parasitic copepods. Parasitic copepods that attack fish are called "fish lice". They are external parasites that attach to the skin or

gills of fish. Serious damage may result if there are heavy infestations of these parasites. The open wounds they leave may lead to secondary infections in parasitized fish. Two important genera of "fish lice" are Argulus and Salmincola.

In summary, although evidence is lacking that links sewage and fish disease or parasites, it is important to consider the aquatic environment and its relationship to disease and parasite infection of fish in any new habitat development program. Conditions that cause stress in fish (crowding, low dissolved oxygen, and malnutrition) are likely to lead to increased incidence of diseases. Under stress conditions, parasite infections may be more serious than in a "normal" situation and cause greater damage to the fish.

Environmental conditions that lead to an increase in intermediate hosts (molluscs and copepods) of fish parasites may increase the incidence of the parasites in fish, especially in ponded water or marshes. The final host (egrets and herons) of some fish parasites may be attracted to the marshes and ponds, increasing the incidence of the parasite.

Crowding fish together increases the possibility of spreading diseases. Crowding fish into localized pockets (in reservoirs or streams) produces a stress condition that lowers the fish's general health and disease resistance. Crowding also brings fish closer together increasing the chance for direct transmission of diseases and parasites. Wounds or abrasion of the epidermal layer may be more prevalent when fish are crowded together. Abrasions in the skin increase the chances of bacterial or fungal infections.

An increase in the mean temperature of the surface water could produce conditions conducive to increased bacterial growth. This could cause an increase in bacterial fish diseases.

The organic load of water could have an effect on increasing bacterial fish diseases. An increased organic load would provide more nutrients for increased bacterial growth. An increased biochemical oxygen demand could result from the increased bacterial growth. This could cause oxygen deficiencies, especially in shallow ponds, which would be a stress factor for fish.

Extreme care should be exercised to prevent introduction of new parasites or diseases into waters where they did not previously exist. Introduced diseases could spread in epidemic proportion among non-immune fish species. Whether or not secondary treatment of sewage

(with disinfection, ie. a combination of chlorination and declorination) will remove or kill diseases or parasites should be studied, especially if the wastewater is received from areas containing fish stocks (tropical fish, fish processing plants, and commercial hatcheries.)

c. Ecological Systems

The most important consideration in the Suisun Marsh area is the relationship between competing plant species, their salt tolerances, and their food value to waterfowl (Ref. 65). Alkali bulrush (Scirpus robustus) has the highest overall use by waterfowl of the 35 major plant species found in the marsh. It receives continuous use (for feed) by an estimated 88 percent of the waterfowl throughout the fall and winter months. However, alkali bulrush covers only six percent of the marsh. Alkali bulrush requires 7 to 8 months of flooding for optimum growth. Less than two months or more than eight months of flooding reduced its competitiveness with other plants which are less desirable waterfowl food. Nonsubmerged plots of alkali bulrush are vulnerable to overgrazing by cattle. Some areas of the Suisun Marsh are grazed by livestock, particularly areas adjacent to the Grizzly Island Wildlife Refuge.

The second most important factor in controlling the growth and distribution of plants in the marsh is soil salt concentration. The month of May seems to be the most critical month in the production of seed heads on alkali bulrush. During this month the plants require more water due to the increased metabolic energy associated with seed formation. After seed formation in May, there is a reduced impact of soil salinities on alkali bulrush. Dominant alkali bulrush stands occupied soils that displayed mean annual salinities ranging from 6,900 - 32,500 ppm Total Dissolved Solids. The lowest concentration (TDS) are usually observed in March and the highest in September.

There is an east to west increase in the salinity gradient of the marshland. It is most evident in late summer and considerably reduced in mid-winter. This gradient affects the distribution of marsh plants; the more salt tolerant species being found on the western edge of Grizzly Island. Kaushik (Ref. 124 found that alkali bulrush did not germinate at salinity levels above 13,500 ppm TDS, but that the present marsh water quality of 6,000 to 8,000 ppm TDS would allow 25 to 40 percent of the alkali bulrush to germinate without providing an advantage to cattail seeds (low TDS germination).

Alkali bulrush is the most used and selected plant food of waterfowl wintering in the Suisun Marsh. Its successful propogation depends upon

soil salinity, preferably of approximately 9,000 ppm TDS and below 16,000 ppm TDS during the month of May (seed production). Flooding of the marsh until mid-June accomplishes this, and also inhibits pickleweed growth (requires high TDS). Withdrawal of water after mid-June helps in controlling cattails which compete with alkali bulrush and have no food value for waterfowl.

If there is a reduced freshwater outflow to the area around Suisun Marsh (reduced flows of waters to Sacramento-San Joaquin Delta), the salinity of the water will increase. Waters of 17,000 - 18,000 ppm TDS will move as far upriver as Honker Bay causing 75 percent of the marshland to experience greatly increased salinities. If this water is applied to the marsh, a significant reduction in alkali bulrush stands would occur with a considerable increase in the less desirable pickleweed.

A major impact on the waterfowl would result if the food supply was drastically reduced. Waterfowl would be displaced to surrounding marshes in San Francisco Bay which do not have the carrying capacity present at Suisun Marsh. Displaced waterfowl would cause potential crop depredation problems, and eventually survival of displaced waterfowl would be impossible.

d. Recreational Resources

The gross recreational user potential available to Site 4 was determined to be 28,100 million visitor days. The salmon, steelhead and striped bass fishery surrounding the site is quite good. In addition, duck hunting within the area is rated among the best in the state. Grizzly Island Wildlife Area, which includes most of the site, is a major public hunting area as well as a popular fishing ground. That part of Site 4 not included in the state wildlife area is occupied by private waterfowl hunting clubs.

In addition to hunting and fishing, wildlife observation, power cruising and sailing are popular recreation activities in the area.

Present Public Facilities: Grizzly Island Wildlife Area is a state-managed game refuge and public hunting and fishing ground. During the waterfowl hunting season, a major portion of the area is opened to public shooting three days a week. Parking and restroom facilities are the only site improvements made available to the public. Fishing access to the area is year round. This state wildlife area is the only public recreation facility within Site 4.

A public boat launching ramp on refuge land along Montezuma Slough is maintained by the Department of Fish and Game, but is not subject to normal refuge regulation as it exists adjacent to a county road and enjoys unlimited public access. There are no parking or docking facilities available at the ramp.

Present Private Facilities: There are 15 privately operated waterfowl hunting clubs within the boundaries of Site 4. Individual acreage and membership varies from club to club and year to year. At present there are 11 separate landowners with clubs on Grizzly Island. Although duck hunting is the dominant recreational activity on the private areas, some fishing, dog training, and birdwatching also takes place on these areas (Ref. 81)

Hunter and Angler Use: Because the majority of Site 4 lies within a state wildlife area, accurate records of hunter and angler use are available. The following data are the most recent compilations of hunting and non-hunting use of Grizzly Island Wildlife Area.

Man Days of Non-Hunting Use - Grizzly Island Wildlife Area - July 1970 to June 1971*

Activity	Man Days
Fishing	7,558
Field trails	3,198
Dog training	1,014
Sightseeing	2,047
Nature study	788
Boat ramp	80
Miscellaneous	83
Total	14,768

* Modified after unpublished report, California Department of Fish and Game, Grizzly Island Wildlife Area, 1971.

Hunting use of the state wildlife area is also accurately tabulated. In addition, the Department of Fish and Game unit manager for the area has begun compiling use figures for the private duck clubs within Suisun Marsh. State area figures are given in number of individual hunters while private club figures are given in hunter days.

Year	Grizzly Island State Wildlife Area	Private Clubs Within Study Area
1968	17,405[1]	- 0 -
1969	21,616[1]	- 0 -
1970	20,004[1]	- 0 -
1971	21,867[2]	2,119[3]

[1] California Department of Fish and Game, May 1971, Public Shooting Area Operations - Waterfowl, data sheet.

[2] Ref. 63.

[3] Ref. 81.

Open Space: The entire Site Area has been designated by the Solano County Planning Department as open space for the preservation of natural resources (fish and wildlife habitat). The long-range plan, as specified in the recreation element of the county general plan, is to maintain Grizzly Island as an area of outstanding scenic and conservation value (Ref. 79). In order to do this, the area has been zoned as open space to avoid premature development or urban encroachment.

Future Public Facilities: At present there are no plans for further recreation development within Site 4. As mentioned in the open space discussion, the county is seeking to preserve this area for its wildlife habitat potential. The Solano County Parks and Recreation Department feels that further development of recreation facilities would only detract from the present value of Suisun Marsh. Grunwald Associates of San Francisco are presently working on an open space study of the entire county. From this study, the county hopes to make a more accurate evaluation of Grizzly Island's recreation potential (Ref. 61).

e. Protected Waterways Designation

The Suisun Marshes are designated as a Class I (premium) scenic, fishery, wildlife and recreation waterway by the California Protected Waterways Plan. The plan also classifies the waters of Suisun Marsh as Class I for striped bass and sturgeon. Suisun Bay is rated as a Class I striped bass fishery.

Montezuma, Suisun, and Cordelia Sloughs have been suggested by Solano County to be included in the California Protected Waterways Plan.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

The archaeological potential of Site 4 itself is apparently nil. What archaeological potential that does exist is limited to the low foothills on the periphery of the Site Area, particularly the Montezuma Hills to the west and the Potrero Hills to the north. No archaeological site surveys have reportedly been undertaken and no future plans for undertaking any exist (Ref. 11).

There are no historical landmarks within Site 4. The nearest apparent one is the Hastings "Montezuma House", reportedly the second oldest intact adobe house in Solano County (Ref. 11). The site is located on the property of the Pacific Gas and Electric Company in the vicinity of Collinsville, just southeast of the Site Area.

b. Scenic Locations

The entire Suisun Marsh is classified as a premium (Class I) scenic waterway in the California Protected Waterways Plan (see Section A-3e). Since Site 4 lies completely within the Suisun Marshes, it is therefore a state recognized scenic resource area. Its scenic value is derived not only from the waterways and their associated plant communities, but from the year-round diversity of an abundant bird life. On clear days, one can view Mt. Diablo in Contra Costa County to the south and the Sonoma Mountains to the northwest. (Ref. 30.)

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact of wastewater land application to Site 4 is the change in species composition in Suisun Marsh.

Discussion: The Suisun Marsh is a brackish water plant community (salt water, freshwater and intermediate plant forms.) The more salt tolerant plants, such as pickleweed and saltgrass, are abundant on the western edge of the marsh where salt concentrations are higher. Pickleweed has its greatest competitive advantage at salt concentrations above 31,000 ppm.

Alkali bulrush is an intermediate salinity marsh plant. The most favorable mean annual level of TDS for alkali bulrush growth and competitive ability is 22,000 ppm. During the month of May when seed heads are forming, soil salt concentrations are critical. The most suitable soil salt concentration at this time is in the vicinity of 7000 to 14,500 ppm.

There is an important relationship between alkali bulrush and its food value for migrating ducks. Alkali bulrush is the major food item of an estimated 88% of the wintering ducks (mallards, pintails, shovelers, and green-winged teal) in the marsh.

Designed applications of wastewater would create optimum growth of alkali bulrush which would be beneficial to the waterfowl on the marsh. Wastewater could be used instead of the present source of water from the adjacent Montezuma Slough but the frequency of application would have to be adjusted for the difference in water quality. (See B-14,15,29,30.)

Over application of wastewater in the Suisun Marsh could reduce the amount of alkali bulrush available to ducks by lowering soil salt concentrations and giving a competitive advantage to freshwater tolerant plants (especially narrowleaf cattail.)

Olney bulrush, narrowleaf cattail and baltic rush are the dominant freshwater inhabiting plants of the marsh. Mean annual soil salinities below 16,200 ppm offer the best competitive advantage to narrowleaf cattail. These plants are more common on the eastern edge of the marsh or areas with salt concentrations low enough to allow the plants to grow.

This impact is specific to Site 4 and represents a central issue in the management of the marsh with wastewater. The importance of Site 4 to waterfowl and wildlife is that it is a wetland. (Suisun Marsh 10% of remaining wetlands.) (See B-14.)

Remedial, Protective and Mitigation Measures: Apply wastewater only during the time of the year when it is needed to prevent serious salt water intrusion. Apply during late summer-early fall.

Mix wastewater with salt water in the proportions to achieve soil salinities of 9,000-16,000ppm that would allow optimum growth conditions for alkali bulrush.

b. Impact 2

The second impact is the prevention of extensive salt intrusion into the marsh, especially during summer and fall months and "abnormally dry" years, and possible future losses of waterfowl habitat and waterfowl.

Discussion: During dry years, such as 1963-64, freshwater may barely reach the eastern edge of the marsh at Montezuma Slough.

Future predictions indicate that 75% of the Suisun Marsh will be experiencing salt concentrations now found only at the extreme western edge, because of decreased freshwater flows into the estuary. By 1990 polyhaline water (18,000 mg/l - 30,000 mg/l TDS) occur as far as Honker Bay on the eastern edge of the marsh. Extremes in salt water intrusion would encourage the growth of less desirable waterfowl food items such as pickleweed and saltgrass at the expense of alkali bulrush and fat-hen (desirable waterfowl food). A decrease in the desirable food items would decrease the carrying capacity of the marsh for waterfowl. (Ref. 65.)

This impact is specific to Site 4 and is very important; it is interated with Impact No. 1.

Remedial, Protective and Mitigation Measures: Application of wastewater in the amounts necessary, and when needed, to prevent extreme salt water intrusion into the Suisun Marsh and to encourage the growth of alkali bulrush instead of pickleweed.

c. Impact 3

Impact No. 3 would be the reduction of existing water quality through the application of secondary-level treated wastewaters.

Discussion: The quality of waters adjacent to Site 4 vary considerably depending upon the time of year (Ref. 140). TDS may be extremely high in late summer or fall (over 2000 ppm) and may be lower in the spring (under 500 ppm) when freshwater runoff is high.

The following values illustrate these variations and their comparison with estimated water quality of recoverable wastewaters.

TDS Existing Water	Surface Drainage 154-8440 mg/l	Groundwater and Subsurface 250-2560 mg/l (970 median)
% of time under 200 mg/l (mid Jan-mid Feb)	4%	
% of time under 300 mg/l (mid Jan-Feb)	12%	
% of time under 500 mg/l (Jan-March)	24%	
% of time under 1000 mg/l (Jan-April)	33%	
% of time over 2000 mg/l (late April-Sept, mid Oct-Dec)	65%	
% of time over 3000 mg/l (most of May, June-Sept)	42%	
% of time over 5000 mg/l (Aug-Sept)	17%	

The estimated upper TDS limits of the recoverable wastewaters exceed existing water quality conditions about two-thirds of the time, generally between May and Dec; estimated lower limits would exceed them about 20 percent of the time, between Jan and mid-March.'

Nitrogen and phosphorous in the recovered wastewater could cause "algal blooms" in Montezuma Slough, particularly if they exceed recommended water quality values, ie., 1.0 ppm total nitrogen (TN) and 0.1 ppm total phosphorous (TP). The effect of TDS in the recovered wastewater would be problematical because of the variations in TDS in existing surface waters. High TDS (over 1,000 mg/l) is known to reduce the reproductive capacities in some fish species such as sunfish, carp, and striped bass.

In the Sacramento-San Joaquin Delta, striped bass usually spawn in areas where the TDS is below 200 ppm. Existing water quality condition would indicate their practical exclusion from the Site Area. Ninety percent of striped bass eggs are recovered in these low TDS areas, although one year eggs were recovered in water with TDS concentrations of 500-100 mg/l in the Delta (Ref. 101). Striped bass spawning is not thought to represent a significant use of Site 4; however it is a nursury area for striped bass fry.

Waters which are rich in nitrogen and phosphorous can have algal "blooms" of such magnitude that fish and other aquatic animals may be killed by associated sags in available oxygen (oxygen used by the living and decomposing algae).

Algal blooms which lead to development of anaerobic conditions could cause conditions that influence increases in avian botulism. This aspect will be discussed in more detail later.

The waters collected in drainage ditches and canals (surface and sub-surface) may have TDS values in excess of those values which affect fish production. TP and TN values are judged to exceed those values that encourage algal growth. See B-11 (existing water quality.)

Drainage waters which are pumped out of the fields on Grizzly Island into Roaring River Slough and other outflowing drainages will be diluted. The introduced waters will add to the TDS, TN, and TP load already carried by these waters, as well as adding an additional organic load. See A-26 estimated water quality-treated waters year-2000.

Remedial, Protective and Mitigation Measures: Recovery canals should not be expected to have a sustaining sport fishery in areas of high TDS.

Monitoring of all outflows will be necessary to control the water quality of the effluent. High TDS, TN, and TP waters may require pre- or post-application treatment to prevent degradation of surface or ground waters. Due to the many variables and the need for testing, it is unknown whether land application will remove these to safe levels.

d. Impact 4

The fourth impact is the possible increase in heavy metals and miscellaneous organic poisons which may be toxic to fish and wildlife.

Discussion: Heavy metals concentrations in the wastewater could become concentrated in plant and animal tissues. This potential impact is not expected to be significant because treatment should be able to remove these heavy metals to trace quantity levels.

Remedial, Protective and Mitigation Measures: This will probably not be a problem if heavy metals are reduced to trace amounts in the treated wastewater.

e. Impact 5

The fifth impact is the loss of wildlife species through loss of habitat (lands, vegetation) to general project facilities.

Discussion: Existing wildlife habitat will be lost in proportion to the number and acreage of proposed project facilities. The number of

facilities and the areas they will cover can only be determined from the engineering design planning stage of project development. The area to be converted, however, is not expected to be large.

Remedial, Protective and Mitigation Measures: When individual wildlife species are at their carrying capacity, the loss of habitat will result in the loss of individuals proportional to the loss of habitat. This wildlife loss can be mitigated if new wild land habitat is developed from lands with other uses. If new habitat is not provided, wildlife will be lost in proportion to the conversion of habitat. If the carrying capacity has not been reached in similar adjacent habitat, then animals displaced by the project will find a suitable place to live, but whether they will increase the population size beyond one season is problematical.

The placement of project facilities should be chosen to produce to least impact, or if possible, to enhance the value of the area by the creation of alternate habitats.

f. Impact 6

The sixth impact is the possible loss of land being managed for dry land grain production.

Discussion: Approximately 2,400 acres of land north of Grizzly Slough within Grizzly Island Wildlife Refuge is being used to grow grain, such as barley, primarily to feed geese in the fall and winter. The barley is dry farmed, using the moisture available in the ground without irrigation.

Flooding this land with wastewater could make it impossible to raise grain and therefore it would remove the land as geese habitat (geese prefer dry land to forage on). For example; white fronted and snow geese will eat rice, Canada geese prefer grain.

Remedial, Protective and Mitigation Measures: The loss of the geese habitat by flooding could not be mitigated, though the flooding of their land would produce additional duck habitat, particularly if food crops such as alkali bulrush are available.

The 2,400 acres used for dry farming could be excluded as a wastewater application area.

g. Impact 7

The seventh impact is the personal contact of wastewater with persons

using facilities on Site 4.

Discussion: Hunters, fishermen, nature observers, Grizzly Island Refuge personnel, and private duck club personnel using the resources of Site 4 could come into direct bodily contact with wastewater before or during application. Chlorination of the water following its secondary treatment would probably eliminate the possibility of disease, but psychological objections would be evident in the persons affected. Once the wastewater is on to the ground, its presence would probably not be as distasteful as that associated with aerial contact.

Remedial, Protective and Mitigation Measures: Routine checks on delivery pipe to prevent leakage of wastewater before its land application.

Regulate public entry into pumping and open conveyance facilities, and into zones of active wastewater dispersal.

h. Impact 8

The eighth impact is the possible increase in the waterfowl disease avian cholera (*Pasteurella multocida*).

Discussion: Avian cholera has occurred intermittently on Grizzly Island, It affects waterfowl; but during severe outbreaks gulls, herons, owls, sandhill cranes (a rare species) and shorebirds may be affected. The disease may appear suddenly and kill hundreds of waterfowl. It has a high incidence of occurrence in late December and early January. Avian cholera occurred annually at Grizzly Island during the 1950's, but a change in water management practices terminated further outbreaks. See wildlife disease discussion (Site 4) for a more complete discussion of avian cholera.

Remedial, Protective and Mitigation Measures: Drainage of ponds after hunting season to disperse large waterfowl flocks to other areas and kill the bacteria.

Flush contaminated ponds with wastewater. The dilution would decrease the opportunity for further infections.

i. Impact 9

The ninth impact is the possible increase in the waterfowl disease avian botulism (*Clostridium botulinum*).

Discussion: Avian botulism has occurred on rare occasions at Grizzly Island. It is caused by a toxin formed by the anaerobic bacterial species *Clostridium botulinum* Type C. Avian botulism has the potential to kill millions of ducks, coots and shorebirds, which develop the disease by ingestion of aquatic invertegrate animals which contain the toxin. Warm temperatures, anaerobic conditions, and decomposing organic matter contribute to the appearance of botulism.

Shallow standing water, especially if created by a "feather-edge" is a factor associated with causation of the disease. "Feather-edge" refers to a gradually sloping pond bottom that allows for extensive shallow water areas less than 18 inches deep. Shallow water (ie., under 18 inches) may be considerably warmer than deeper water areas, and if anaerobic conditions exist, may increase the production of the botulism bacteria.

Algal blooms are important contributing causes of botulism because they provide nutrients for increased invertegrate growth, which die and are eaten by waterfowl. The algae creates a high biochemical oxygen demand, which is the oxygen utilized by bacteria during decomposition of the algae. The oxygen may be completely consumed by the bacteria, creating anaerobic conditions, which promote the growth of *Clostridium botulinum*, the causative agent of avian botulism.

High levels of wastewater application in the summer could result in botulism if some flooded areas contained "standing" water, especially shallow water (under 18 inches deep) for periods longer than 15 days.

Refer to wildlife disease discussion (Site 4) for a complete description of avian botulism.

Remedial, Protective and Mitigation Measures: Botulism could be avoided by continuous flow or circulation of water and maintenance of depths at 18 or more inches on all areas consistent with the waterfowl food plant requirements.

Ponds could be constructed with continuous flow between one unit and the next and with a final discharge into Montezuma Slough.

j. Impact 10

The tenth impact is the possible reduction of waterfowl populations.

Discussion: Flooding the marsh with wastewater the entire year could result in the increased growth of tules and cattails which have no food value for waterfowl. Too little wastewater could result in increased salinity intrusion and promote the growth of saltgrass and pickleweed, which have a poor selected value as waterfowl food.

Avian cholera could increase if large amounts of wastewater were present after hunting season and were prevented from being drained off the land.

Avian botulism could also increase in occurrence if stagnant, shallow pools (under 18 inches deep) of wastewater were present.

All of these factors would contribute to a serious reduction in the waterfowl populations that winter on Grizzly Island and adjacent areas.

Remedial, Protective and Mitigation Measures: Control flows of wastewater into Site 4 until such times that they are needed, such as spring.

An agreement should be entered into with the present management of Site 4; (Fish and Game, State of California) to deliver beneficial quantities of water to them.

k. Impact 11

The eleventh impact is the possible reduction in the number of birds taken by hunters.

Discussion: A reduced hunter take would occur if waterfowl populations declined, or if operation of the present project reduced huntable land or interfered with hunting.

Remedial, Protective and Mitigation Measures: Proper management techniques to prevent population declines (see Remedial, Protective and Mitigation Measures for Impact 10).

l. Impact 12

The twelfth impact is the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion: Some wildland habitat on each wastewater application site will be lost to permanent structures of the project. The amount of land lost and the degree of lost biological productivity (eg., forest,

grassland, brush, marsh, etc.,) cannot be quantitatively determined until site locations for these structures are selected. The percentage of the total lands so converted is expected to be low. However, their placement within the Site Area may have significant impact on some adjacent uses.

Remedial, Protective and Mitigation Measures: Permanent commitment of land precludes in-kind remedial or mitigation measures, but landscaping of bordering areas provides some mitigation. Faoility location should be chosen so as to produce a minimum adverse impact. Beneficial effects may be created by off-site compensation of land-use.

m. Impact 13

The thirteenth impact is the loss of vegetation, wildlife habitat, and wildlife on whatever excavated materials result during construction of the facilities.

Discussion: Native vegetation and wildlife will be lost on the areas permanently committed to receiving spoil from construction of the distribution system. The actual amount of land lost to spoil can only be determined from the detail engineering design phase of project development. The relative amount is expected to be very small.

Remedial, Protective and Mitigation Measures: Lands permanently under spoil are no longer productive and available to wildlife. Revegetation with native species and re-establishment of the native habitat on the spoils will restore food and cover to the resident wildlife species, and renew scenic values.

In more detail design phases of project development, consideration should be given to stock piling topsoil for future revegetation operations.

n. Impact 14

The fourteenth impact is the possible degradation of recreational fishing due to introduction of diseases and parasites carried by the recollected wastewater.

Discussion: The probability of occurrence of this impact is remote since all wastewaters will have received disinfection as well as secondary and soil mantle treatment. It is identified to emphasize the importance of isolating surface runoff from adjacent waterways having potential fishery values.

Remedial, Protective and Mitigation Measures: Initiate whatever measures are necessary to prevent the increased parasite load, such as:

- Pre- or post-application treatment of wastewater to prevent

degradation of surface water quality.

- Prevent the introduction of new parasites or diseases.
- Prevent increases in intermediate host species or control of these species if prevention is impossible.
- Control wastewater temperature to a level that would not greatly increase the temperature of surface waters.

o. Impact 15

The fifteenth impact is the possible introduction of fish diseases and parasites into areas that they did not previously occur in by the application of treated wastewater.

Discussion: Fish diseases and parasites from tropical and other nonendemic fish may be introduced into surface waters that contain fish populations native to the wastewater management areas. Diseased or dead tropical fish from homes or commercial businesses are commonly disposed of in sanitary wastes. The disease or parasite organism could easily pass through secondary treatment of sewage water and may or may not be killed by chlorination (depends on chlorine load and the organism). A new disease or parasite introduced into an area of low immunity to that disease could result in an epidemic in the fish population. However this possibility is remote.

Remedial, Protective and Mitigation Measures: Post-secondary treatment analysis of the wastewater to determine the presence, if any, of potential pathogenic organisms or parasites of fish.

Possible use of additional post-treatment measures to kill pathogenic organisms by use of ozone or ultra-violet light.

p. Impact 16

The sixteenth impact is the possible increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of wastewater.

Discussion: Some aquatic snails and copepods (microscopic invertebrates) are the intermediate hosts for certain fish parasites, such as yellow grub worm, bass tape worm, and certain flukes. Wastewater could increase the production of copepods by increased nutrient levels in the water. If the specific copepods that act as intermediate hosts for fish parasites are present in the water, their numbers would increase also. This could increase the numbers of copepod parasites that directly parasitize fish.

Increased habitat for aquatic snails could be created by addition of waste-

water to heretofore dry or intermittent streams, by the creation of reservoir (s) for wastewater storage, and by the creation of marsh conditions in the rapid infiltration areas. If a marsh is created by wastewater application from a dry area the resultant marsh won't be any worse than a natural marsh unless nutrient levels were higher than the natural marsh.

Herons and egrets, which serve as final hosts in the life cycle of such fish parasites as the yellow grub and red roundworm may increase in numbers because of increased habitat (marshes and waterways). These birds may transmit the parasite from one waterway to another in their daily feeding pattern.

Remedial, Protective and Mitigation Measures: Pre- or post-application treatment of wastewater to prevent large increases of nutrients from entering surface waters.

Prevent wherever possible, increases in the habitat of intermediate and final host species.

q. Impact 17

The seventeenth impact is the increase in fish diseases because of the higher water temperatures of recovered wastewater and increased bacterial growth.

Discussion: Wastewater, if it is used in this area during the summer months to prevent salt water intrusion into Site 4, could increase the mean water temperature of the Montezuma Slough. Wastewater left on the land and exposed to the sun when pumped into the Montezuma Slough could raise the water temperature of the slough. The increased water temperature could stimulate increased bacterial growth, especially if there is abundant organic matter introduced by the wastewater. Bacteria pathogenic to fish could also be increased in thewater. This could be detrimental to fish, especially if they are under stress from some other environment factor (low DO, malnutrition).

Remedial, Protective and Mitigation Measures: Control temperature of the recovered wastewater to a level that would not significantly increase the temperature of existing waterways.

r. Impact 18

The eighteenth impact is an increase in stress factors of fish and their relationship to the susceptability of fish to disease and parasitism.

Discussion: The increased amounts of biostimulants (nitrogen and phosphorous) and organic matter from wastewater that would be disposed of into Montezuma Slough and drainage canals could cause oxygen depletion problems. The oxygen used by bacteria decomposing the organic matter and by algae during endogenous metabolism and decomposition could cause oxygen sags that could cause stress conditions in fish. An oxygen sag in one area of the Montezuma Slough and drainage canals may tend to concentrate fish in areas of adequate oxygen supply. This may bring fish into closer contact and thus, increase disease and parasitism by direct contact. It may also increase physical injury (open wounds) to fish which may promote secondary bacterial or fungal infections, by crowding.

Remedial, Protective or Mitigation Measures: Recovered wastewater should be disposed of in existing waterways that have sufficient water to dilute incoming wastewater.

s. Summary of Sensitive Areas

Figure V-B-2 delineates the location of environmentally "sensitive" areas within Site 4. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

All of Site 4 is considered "sensitive" with respect to recreation and vegetation. From a fish and wildlife viewpoint, Montezuma Slough all along the northern and eastern perimeter of the Site Area and Roaring River Slough running through Sub-Area 4.2 and between Sub-Areas 4.1 and 4.2 are considered "sensitive."

SECTION C

C. WASTEWATER LAND APPLICATION SITE 5: NORTHERN YOLO COUNTY - WOODLAND AREA

1 - Project Development

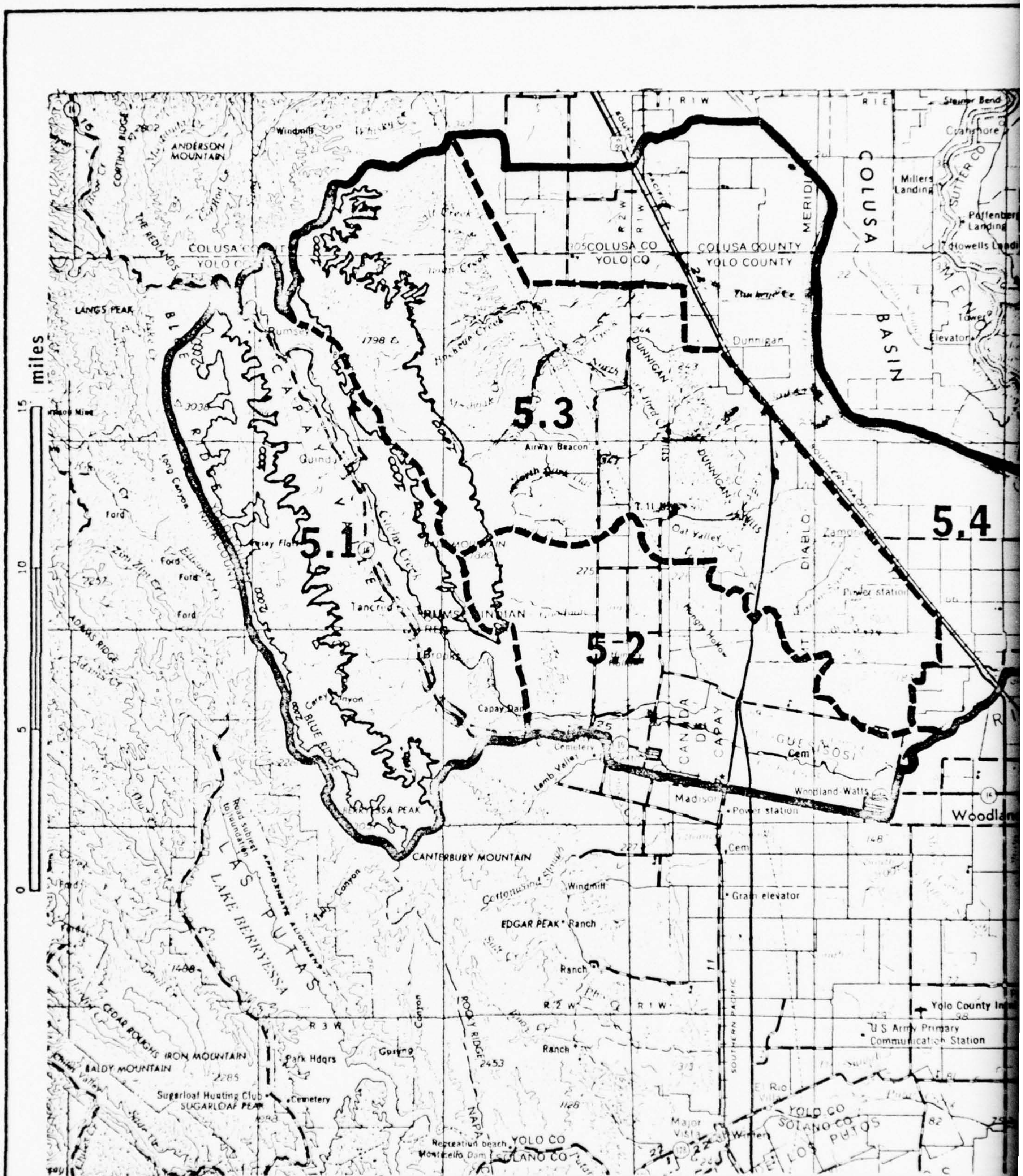
a. Present Land Uses

Site 5 covers practically the entire northern half of Yolo County and projects into southcentral Colusa County and into the southwestern corner of Sutter County and the northwestern corner of Sacramento County. Sacramento is located about 8 miles south-southeast of the site's south-east corner and about 46 miles southeast of the site's northwest corner. Woodland is located just outside the south-central sector. State Route 16 and Cache Creek in Yolo County and Elkorn Road in Sacramento County provide most of the site's southern perimeter. Natomas Road in Placer County and East Levee Road in Sacramento County provide all of the eastern perimeter. The northern perimeter is provided (going west to east) by Elk Creek, Boles, Wyer, and Greenbay Roads, and Clarks Ditch in Colusa County; the Colusa Basin Drainage Canal on into Sacramento County; then Einsley Road, Sacramento Slough, and the Sacramento River; and finally Cross Canal and Howsley Road in Sutter County. Almost all of the western perimeter is provided by the ridge line of the Blue Ridge mountains, most of which also provides a partial boundary line between Yolo and Napa Counties. The Lake Berryessa-Putah Creek drainage lies along most of the western and southern perimeter. Use Figures V-C-1, V-C-2, and V-A-7 for location reference.

Site 5 occupies about 352,600 acres. For study purposes, it has been divided into six sub-areas as shown in figures V-C-1 and V-C-2. These sub-areas and their areas are as follows:

Sub-Area No.	Sub-Area Designation	Area in Acres
5.1	Capay Valley	67,000
5.2	Hungry Hollow	44,700
5.3	Dunnigan Hills	98,800
5.4	Yolo Plains	86,300
5.5	Yolo Bypass	22,400
5.6	Sacramento	33,300

Agriculture is the predominant land use. Crop culture and pasture occupy practically all of sub-areas 5.2, 5.4, 5.5, and 5.6 and most of 5.3. Orchards predominate in the lower elevations of the Capay Valley sub-area 5.1. The site has a moderately extensive systems of roads and is dotted with many small towns.



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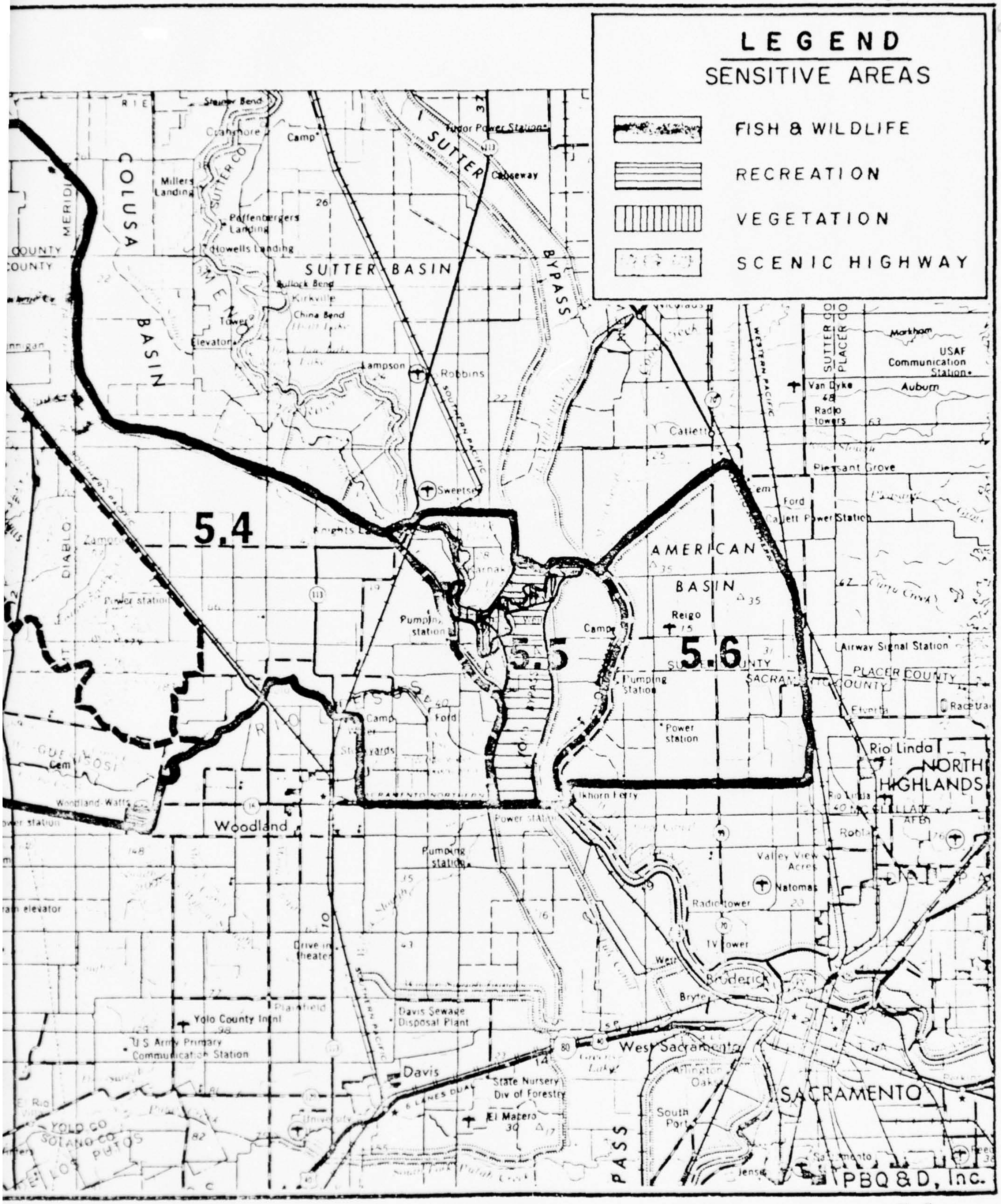

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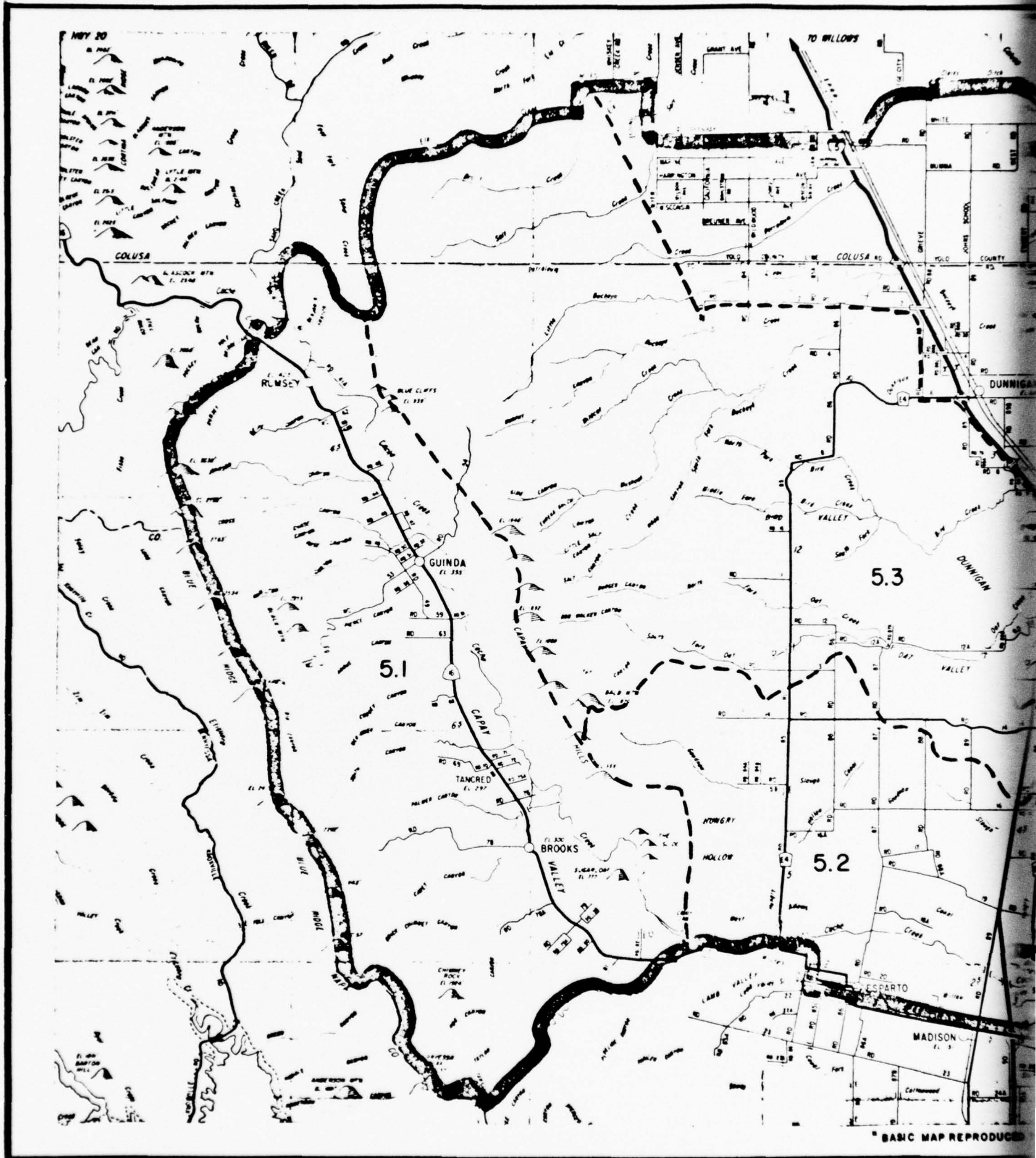

TO WILLOWS
COLUSA
RUMSEY
BLUE CLIFFS
GUINDA
5.1
5.2
5.3
CAPAY
TANCRED
BROOKS
VALLEY
HUNGRY
HOLLOW
DUNNIGAN
ESPARTO
MADISON
LAMB VALLEY
BLUE RIDGE
COLUSA RD
YOLO COUNTY
"BASIC MAP REPRODUCED

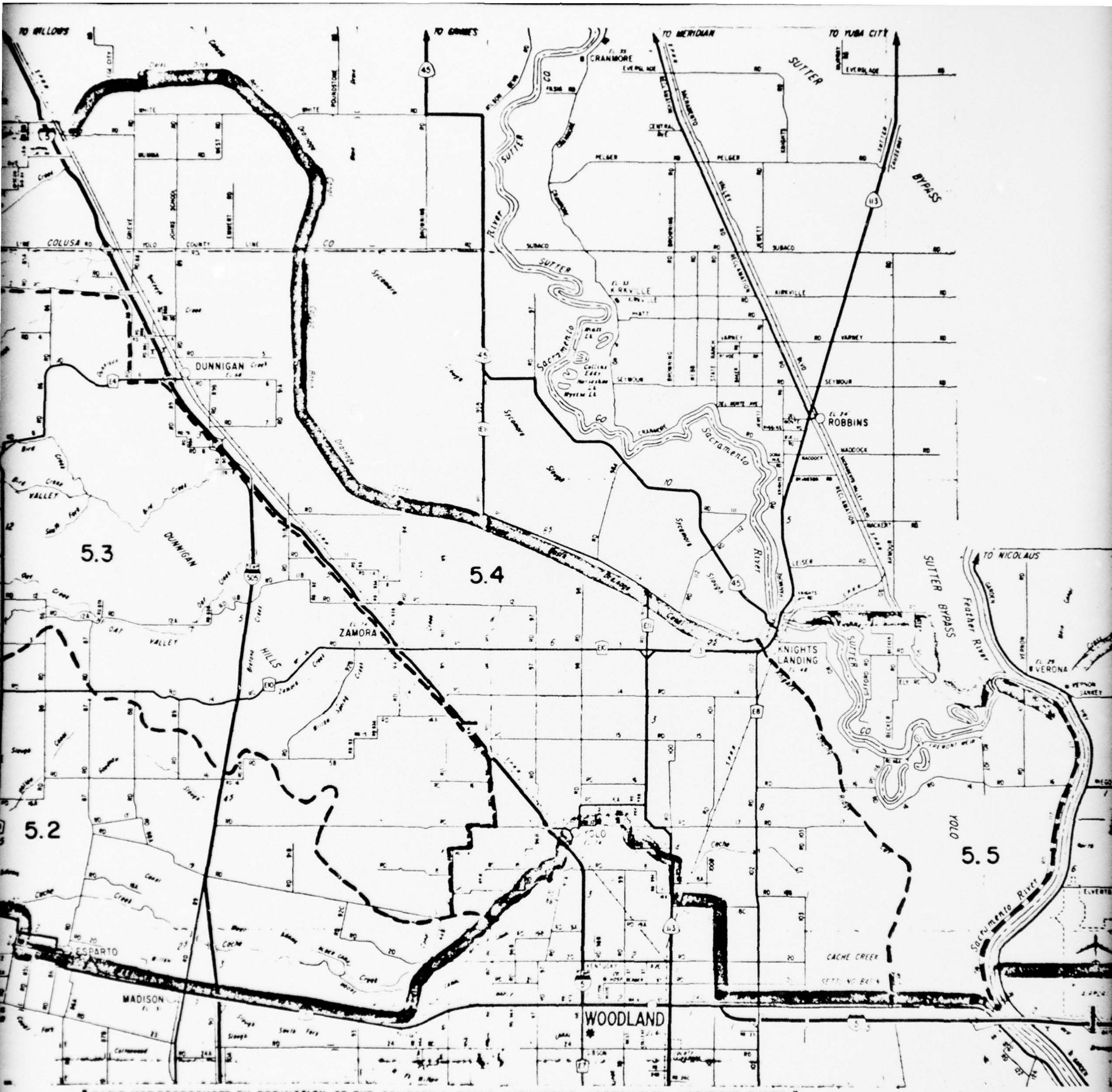
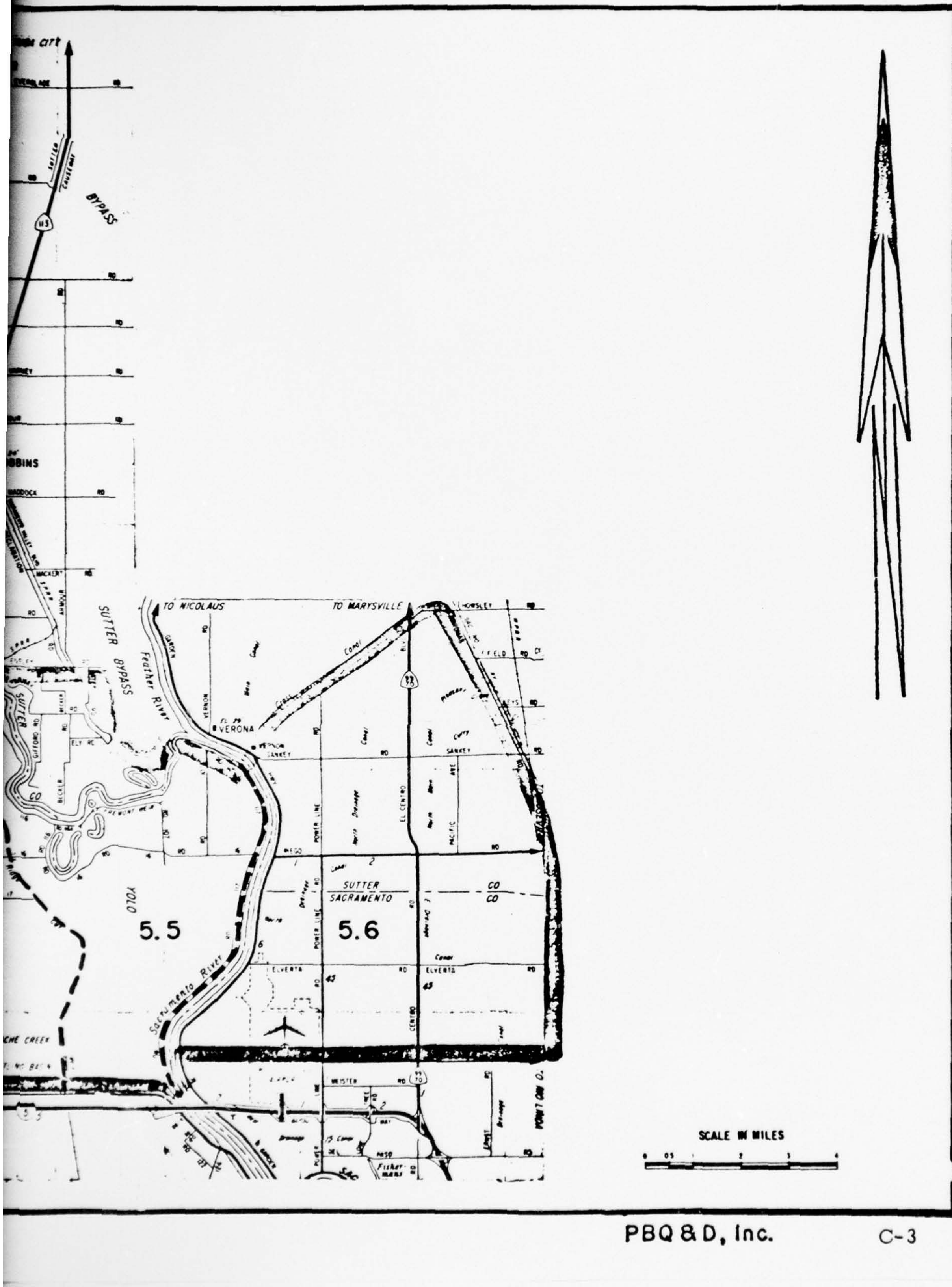

TO WILLOWS
TO GRIMES
TO MERIDIAN
TO YUBA CITY
CRANMORE
SUTTER
SUTTER BYPASS
COLUSA
YOLO
COUNTY LINE
KIRKVILLE
DUNNIGAN
ROBBINS
5.3
5.4
5.2
5.5
DUNNIGAN
HILLS
ZAMORA
KNIGHTS LANDING
TO NICOLAUS
VERONA
Feather River
Sacramento River
YOLO
ESPARTO
MADISON
WOODLAND
CACHE CREEK

Figure V-C-2



PBQ & D, Inc.

Figure V-C-5c

As to possible future development, there are proposals for two dams and reservoirs in the upper Cache Creek Valley that would be part of the State Water Plan: (1) Indian Valley Dam, a local Yolo County sponsored project that has Federal and state support, and (2) Wilson Valley Dam. These projects are both located on the North Fork of Cache Creek which upstream of and outside the Site Area. They would affect, however, the flow regime of lower Cache Creek that is in the Site Area.

b. Development Objectives

This site is the largest of the selected study sites. It includes a variety of major land features, the more significant being the Dunnigan Hills, the Capay Valley and the downstream portion of the Cache Creek Valley, Sacramento Valley lands, and a portion of the Yolo Bypass. The opportunities for development are, respectively, irrigated pasture and/or forests, orchard production with streamflow and groundwater augmentation, and general irrigated cropping and rice production.

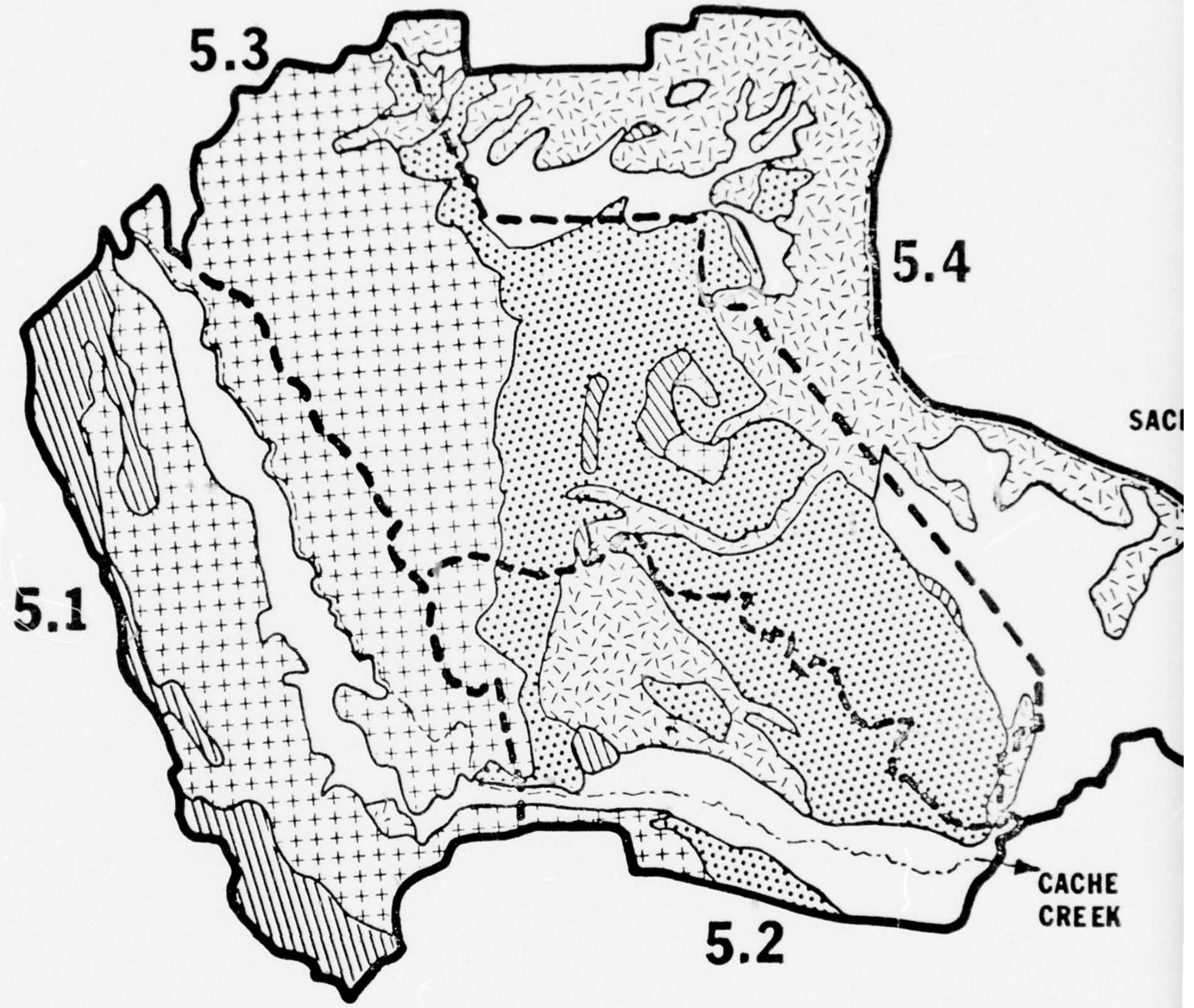
It should be pointed out that the Sacramento Valley and Yolo Bypass intersect the Site Area. Special consideration of the advantages and disadvantages of using these portions of the Site Area have been considered.

It should also be pointed out that there is an overdraft of the groundwater aquifers under the Site Area. This is causing great concern among the water users and they are seeking supplemental water from the proposed Tehama-Colusa Canal.

Site 5 was selected because it is considered reasonably typical of several Central Valley sites. Proposed land uses and types of land application based on soil capabilities are shown in Figure V-C-3. Areas that were excluded because of excessive elevation (over 1500 feet) are delineated in Figures V-C-3 and 4. Areas with slopes over 30 percent predominating are delineated in Figure V-C-4. These areas are being considered for exclusion because of erosion enhancement and possible landslide conditions. These areas were delineated as a result of on-site inspections and subsequent topographic map analysis. Recommended unit application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10.

Sub-area 5.1 encompasses the Capay Valley and constitutes a separate potential project area. The possible development of the Capay Valley sub-area has been discussed in some detail in Section A-7c as an

PROPOSED AND POTENTIAL LAND USES FOR WASTEWATER L



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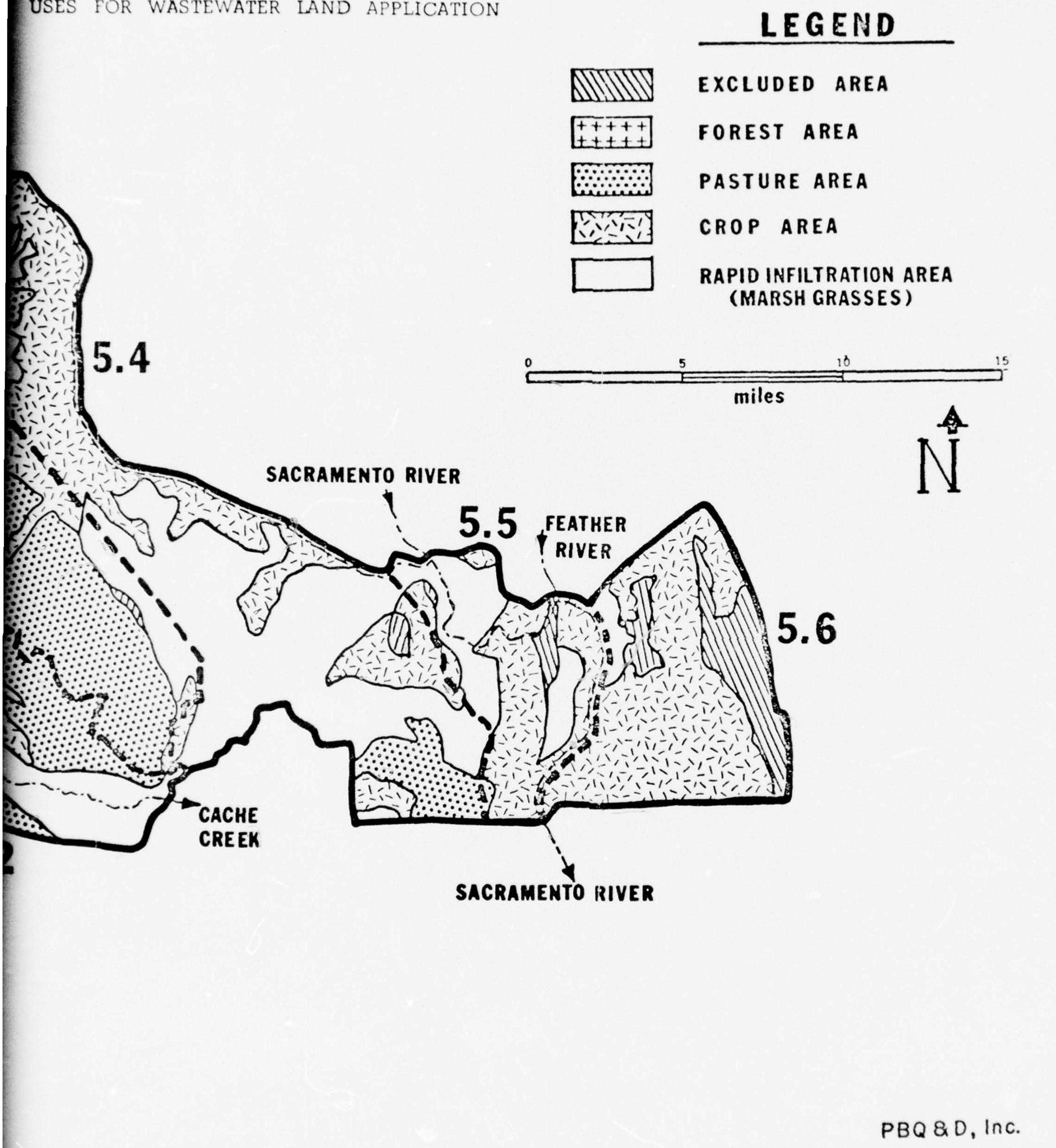
USES FOR WASTEWATER LAND APPLICATION



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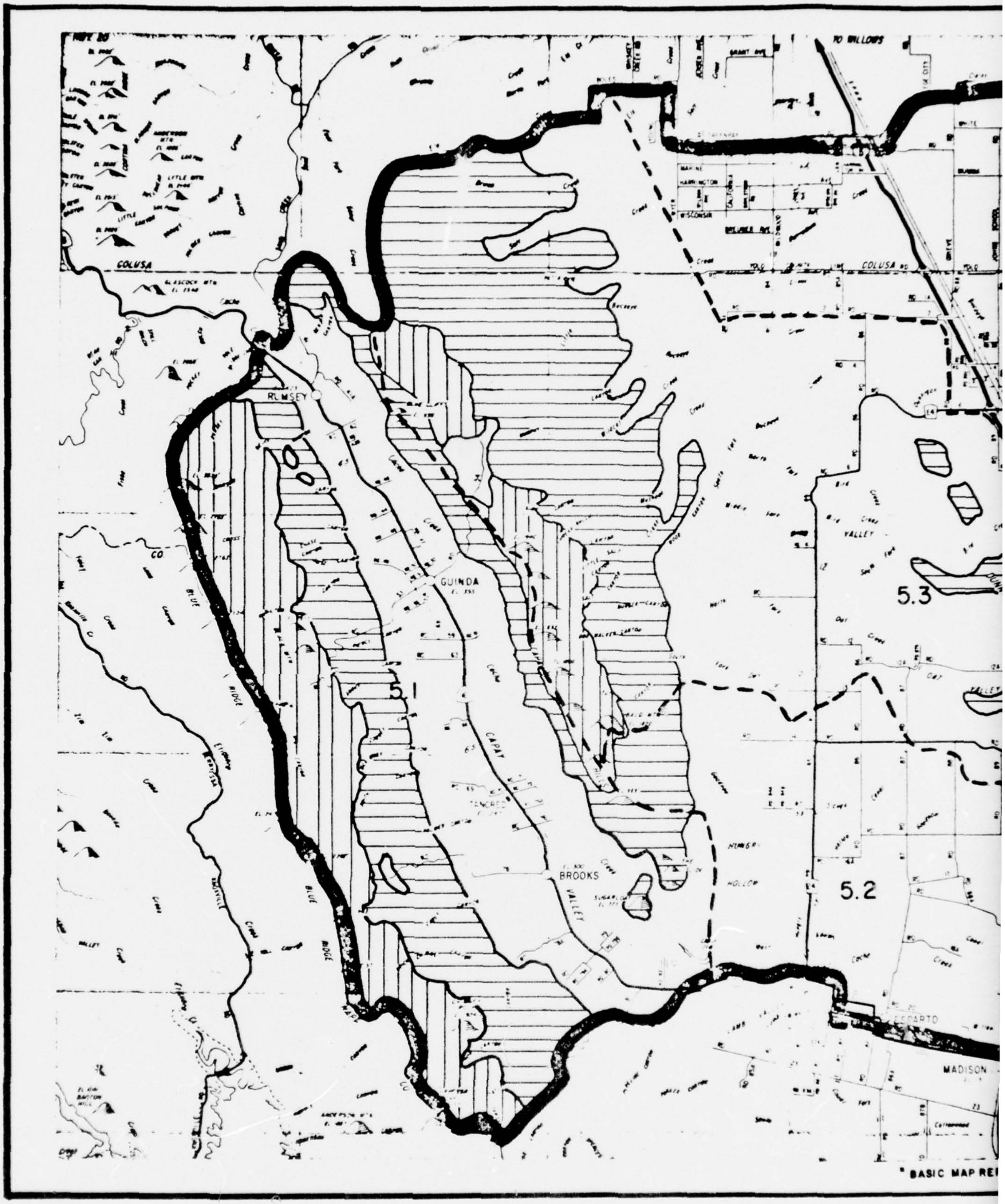
TO WILLOWS
COLUSA
COLUSA RD
RUMSEY
GUINDA
5.1
CAPAY
VALLEY
BROOKS
5.3
5.2
HOLLOW
ESPARTO
MADISON

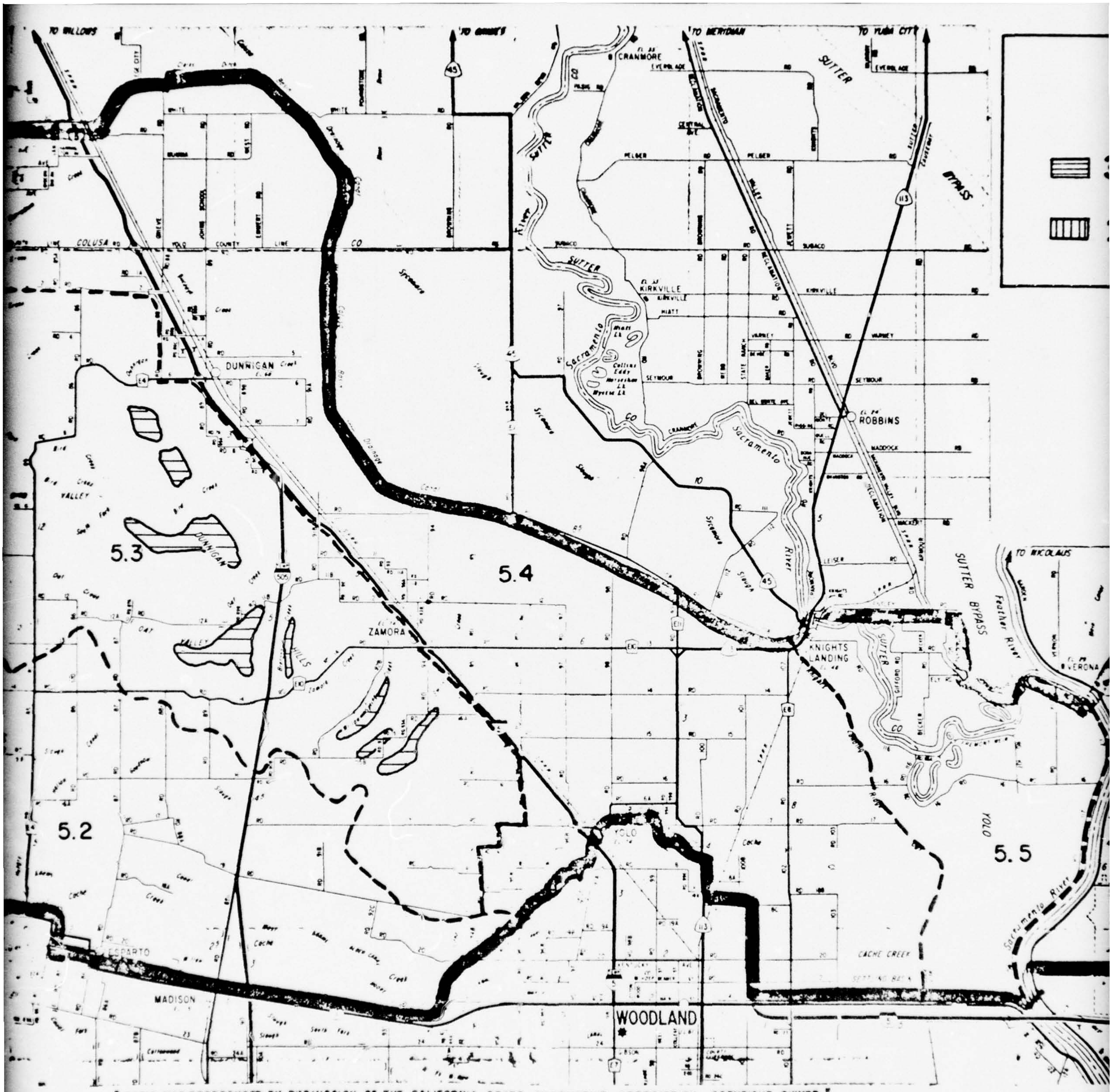

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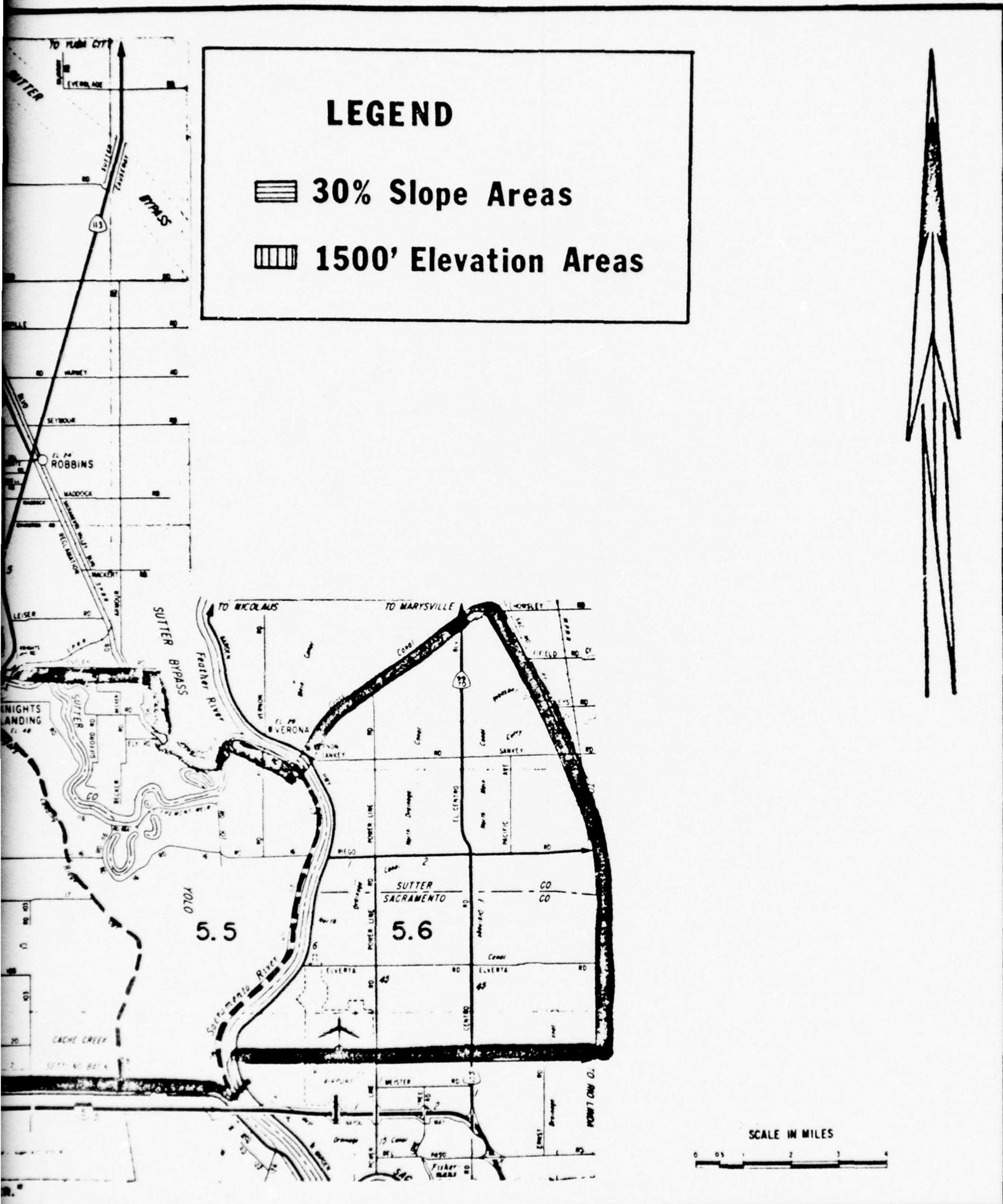
Figure V-C-4



LEGEND
30% Slope Areas
1500' Elevation Areas
SCALE IN MILES
TO YUBA CITY
SUTTER BYPASS
ROBBINS
KNIGHTS LANDING
TO NICOLAUS
TO MARYSVILLE
Feather River
VERONA
SANKEY
RIEGO
POWER LINE
EL CENTRO
PACIFIC
SUTTER CO
SACRAMENTO CO
YOLO
5.5
5.6
Sacramento River
ELVERTA
CACHE CREEK

example of typical site development. A substantial portion of this sub-area is either above 1500 feet in elevation or has slopes greater than 30 percent. Potential wastewater application will probably be confined to the central Cache Creek Valley flood plain where the soils and topography are the most suitable. The other five sub-areas offer much larger proportionate areas for potential wastewater application.

The most probable sources of wastewater for land application are from the Sacramento, Davis, and central Solano County urbanized areas to the south and southeast. The specific combination of sources will depend upon the degree of regionalization in the collection and treatment of wastewaters thought advisable. These treated wastewaters can be brought into the Site along any number of major or minor north-south roadways, with State Route 16 providing the principal east-west distribution path. The distribution and recovery systems will follow the management and development outlines presented in Sections A-7a, A-7b, and A-7c. The estimated quality of recovered land application wastewaters is that presented in Table V-A-7. Since the general conveyance of wastewaters to the Site Area is uphill, it is expected that the distribution system will be designed much like any water supply distribution system complete with pressure zones to minimize pumping costs. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible sources of wastewater indicated above.

The location of conveyance and pumping facilities in the mountainous portions of the western region of the Site will require substantial analysis of flow and pumping requirements in relation to natural topography. The eastern region, however, exhibits little relief, with the exception of the Dunnigan Hills sub-area, and conveyance and pumping facilities could generally be located in alignments unrestricted by topography. Wastewater would be potentially applied to large portions of sub-areas 5.4, 5.5, and 5.6 by surface irrigation, and a combination of application and recovery systems would be required for the hilly and mountainous regions of the Site.

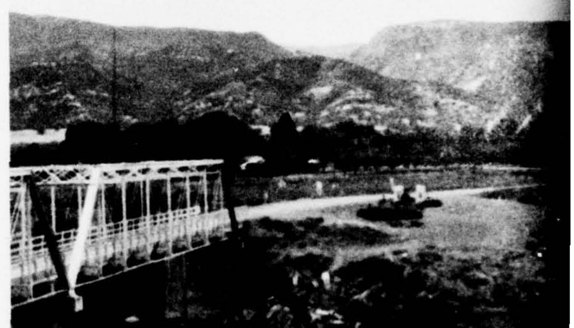
2 - Environmental Setting Without the Project; Geophysical and Geochemical

Site 5 is reasonably representative of a cross-section of the Central Valley and particularly of its northern Sacramento Valley portion. The eastern half of the Site Area is composed of nearly level alluvial fans, flood plains, and basins which are intensively cultivated. The western half is composed of rolling terraces and three successively steeper and higher northwest trending uplands. The easternmost is the rolling Dunnigan Hills which rise to elevations between about 230 feet in the south to about 400 feet in the north. The central uplands are the Capay Mountains which rise to elevations between 939 feet to 1820 feet at Bald Mountain. Between these two lie the Hungry Hollow, and upper Oat and Bird Valley tablelands. The westernmost uplands are the steep eastern slopes of the Blue Ridge range which has peaks ranging in elevation from 1943 feet to 3057 feet at Berryessa Peak at the southwest corner of the Site Area and sub-area 5.1. Between these last two ridge lines lies the Capay Valley. The eastern slopes of the Blue Ridge range are considered part of the Coast Range geomorphic province while the remainder of the Site Area is part of the Central Valley geomorphic province. Elevations range from the 3057 feet at Berryessa Peak down to about 15 in various points in sub-areas 5.6 and 5.5. Figure V-C-5 shows some typical views of the Site Area.

a. Geology and Hydrology

Summary of Geology: The basic subsurface strata in sub-area 5.6 is late Quaternary sedimentary rock basin deposits (i.e., well under one million years old); i.e., deep accumulations of unconsolidated alluvium deposited during flood stages of major streams in areas between natural stream levees and fans, together with late Quaternary sedimentary rock fan deposits along the eastern edge from streams emerging from high lands of Sierra Nevada. The basic strata under sub-area 5.5 is late Quaternary sedimentary rock stream channel deposits, while that under sub-area 5.4 is mostly fan deposits except for some basin deposits along the western side of the Colusa Basin Drainage Canal. These fan deposits extend westerly into sub-area 5.3 up to the Dunnigan Hills. The Dunnigan Hills are primarily made up of older formations, Pliocene non-marine or continental sedimentary and metasedimentary rock strata (1 to 12 million years old, composed of fluviatile and lucustrine silt, clay, silty sand and gravel lenses, and basal beds of tuff). Upper Cretacepus Mesozoic marine sedimentary and metasedimentary rock formations (60 to about 100 million years old) are the oldest ones found in the Site Area and they make up the predominant material of the Capay and Blue Ridge mountains. They are composed of sandstone, conglomerates, and shale.

1. NE Across Cache Creek toward Eastern and Northern Hills at N End of Capay Valley from Highway 16 1 mile NW of Rumsey



3. WSW Across Cache Creek toward Pie
in Blue Ridge Moutains from E Bank o
in Capay Valley on Yolo Cou

4. W Up Cache Creek (dry) Blue Ridge on Horizon from Yolo County Road #85 on Bridge Crossing of Cache Creek

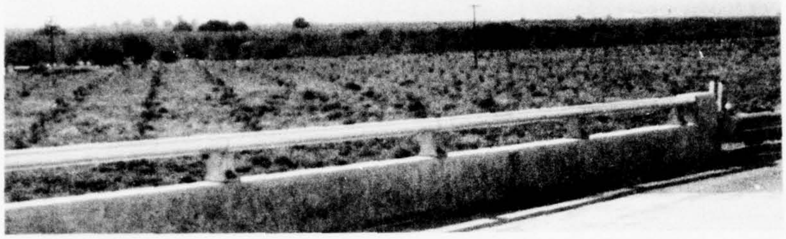
Site 5

2. ENE Down Cache Creek Across a portion of
Capay Valley
from Highway 16 Near Rumsey

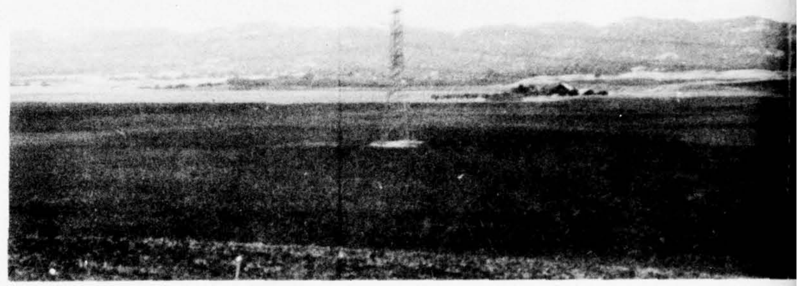
V Across Cache Creek toward Pierce Canyon
lue Ridge Moutains from E Bank of Cache Creek
in Capay Valley on Yolo County Road #54

5. N View of Sprinkler Irrigation in Orchard on
Greenbay Ave. W of Vanter Road

Site 5



6. SW Across Flatlands of Brush Creek Petroleum Creek-Clarks Ditch Drainage- from Greenbay Road Bridge over Interstate 5

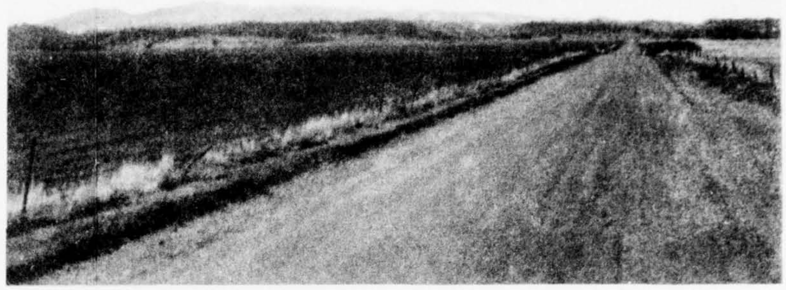


8. SWS toward Oat Creek Drainage tow
Capay Hills with Blue Ridge on Hor
from Yolo Conty Road #85

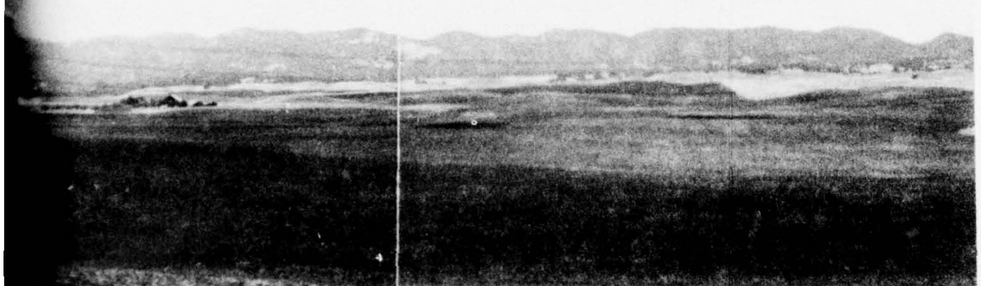
9. SW toward Dunnigan Hills from Intersection of Yolo County Road # 10 & #94

2

Site 5

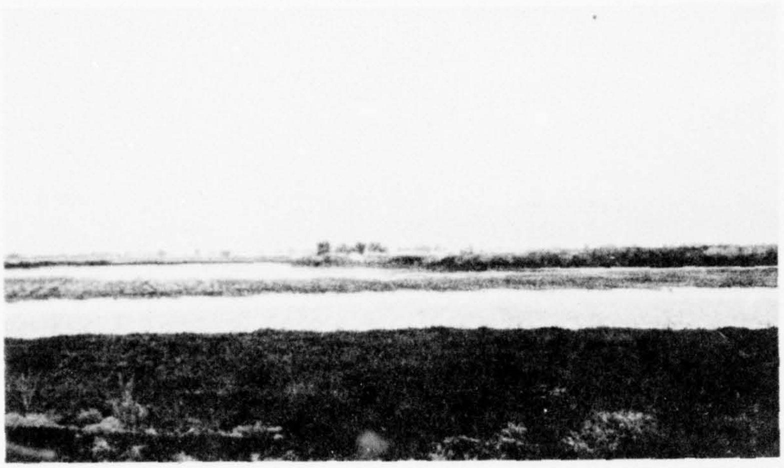


7. West Along Yolo County Road #2 and Intersection of Wildwood School Rd Across Buckeye Creek Dr Flatlands Toward Capay Hills Blue Ridge on Horizon



ward Oat Creek Drainage toward Hills with Blue Ridge on Horizon from Yolo Conty Road #85

10. SW Across Fields toward Dunnigan Hills from NE Corner of Intersection of Yolo County Roads # 13 and # 97



11. NNE Across Wastewater Disposal Ponds - Woodland Sewage Treatment Plant from Yolo County Road #21 Near Intersection of Road #102

13. WNW - NW Up Sacremento Riv
Along S Bank and Across to N Ba
Yolo County Road #116 W of O

14. ENE Across Portion of American Basin from Garden Highway on E Levee of Sacramento River

Site 5

12. ESE Down Sacramento River Channel from Yolo County Road #116

- NW Up Sacramento River Channel S Bank and Across to N Bank from County Road #116 W of Old River

15. S Along Sacramento River also from Garden Highway

The Sweitzer Fault runs along the Capay Mountains. The floor of the Capay Valley is mostly underlain with late Quaternary alluvium while fan deposits underlie most of Hungry Hollow. (Refs. 2, 9.)

Summary of hydrologic systems and water quality conditions: Major elements of the lower Cache Creek drainage basin make up about one-third of Site 5. These elements include the Capay Valley reach (sub-area 5.1), the Hungry Hollow-Goodnow Slough tributary drainage north of Cache Creek and a strip south of Cache Creek and north of State Route 16 (sub-area 5.2), and a small area south of Cache Creek, west of the Cache Creek Settling Basin in the southernmost part of sub-area 5.4. The bulk of sub-area 5.4 and all of sub-area 5.3 is composed of many small stream basins, the latter emptying into the Sacramento River at Knights Landing. A few originate in the Dunnigan Hills. The others originate in the Capay Mountains. Some of these latter, Oat and Bird Creeks, subsequently flow through theDunnigan Hills.

Sub-area 5.5 is composed of diked off elements of the Sacramento River floodplain. The largest section lies west and south of the Sacramento River. The Yolo Bypass runs right through it. The Yolo Bypass is a floodway of the Sacramento River which drains into that river at the north end of the Delta. Cache and Putah Creeks are the predominant tributaries to the Yolo Bypass. A smaller section of sub-area 5.5 lies north of the Sacramento River and in the southern end of what is known as the Sutter Basin, a diked basin between the confluences of the Sacramento and Feather Rivers.

Sub-area 5.6 also is composed of a diked off portion of the Sacramento River floodplain. This portion represents a central section of what is known as the American Basin, a diked basin east of the Sacramento River, south of the Feather River and north of the American River.

A large groundwater basin underlies most of the alluvial flatlands of Site 5. It is part of the great Central Valley groundwater basin. Elements of this groundwater basin underlie all of Cache Creek and completely encircle the central bedrock core of the Dunnigan Hills.

Estimated water quality conditions for the surface and ground waters in and around Site 5 are presented in Table V-C-1. The better quality of the Sacramento River reflects the fresh water inputs from the Feather River and northern watershed inputs. These waters are moderately hard. The values for the Colusa Basin Drainage Canal and Cache Creek reflect their drainage basins and the agricultural activities upstream of the major sampling points. These surface waters vary from being hard

Table V-C-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 5

Water Quality Characteristic	Surface Waters 1/	Ground Waters 1/	Current Standards 3/
Total Dissolved Solids:		214-519 mg/l	no numerical standards
Sacramento R.	94-124 mg/l		
Colusa Basin D. Canal	270-810		
Cache Creek	about 180		
Electro-Conductivity: (in micromhos)		390-1340	nns
Sacramento R.	129-190		
Colusa Basin D. Canal	471-1263		
Cache Creek	337-477		
Total Hardness:		153-454 mg/l	nns
Sacramento R.	52-82 mg/l		
Colusa Basin D. Canal	138-323		
Cache Creek	138-178		
Total Non-CO_3 Hardness:		0-21 mg/l	nns
Sacramento R.	0-7 mg/l		
Colusa Basin D. Canal	0-56		
Cache Creek	0-7		
Total Nitrogen:			nns
Sacramento R.	0.09-0.14 mg/l		
Colusa Basin D. Canal	0.14-0.23		
NO_4-Nitrogen:			nns
Sacramento R.	0.04-0.11 mg/l		
Colusa Basin D. Canal	0.11-0.29		
Total Phosphorus:			nns
Sacramento R.	0.05-0.12 mg/l		
Colusa Basin D. Canal	0.16-0.25		
pH:	7.1-8.8	7.7-8.2	6.5-8.5
Temperature:	44-75°F		nns
Dissolved Oxygen:			nns
Sacramento R.	8.5-11.7 mg/l		
Colusa Basin D. Canal	6.8-11.5		
Cache Creek	10.1-12.4		
Turbidity:			nns
Sacramento R.	4-150 JTU		
Colusa Basin D. Canal	80-600		
Cache Creek	15-450		
Sediments:	under 280 mg/l 2/		nns

Table V-C-1 (continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 5

Water Quality Characteristic		Surface Waters 1/	Ground Waters 1/	Current Standards 3/
Ca:	Sacramento R.	0.12-12 mg/l		nns
	Colusa BDC	27-54	25-70 mg/l	
	Cache Creek	25-32		
Mg:	Sacramento R.	5.8-8.5		nns
	Colusa BDC	18-61	21-52	
	Cache Creek	18-23		
Na:	Sacramento R.	6.6-21		nns
	Colusa BDC	44-157	18-68	
	Cache Creek	15-32		
K:	Sacramento R.	1.1-1.2 mg/l		nns
	Colusa BDC	1.5-3.9	0.2-3.9 mg/l	
	Cache Creek	about 1.7		
CO_3:				
	Sacramento R. & Cache Creek	0 mg/l	0	nns
	Colusa BDC	0-7		
HCO_3:				
	Sacramento R.	63-107 mg/l	256-447	nns
	Colusa BDC	160-314		
	Cache Creek	174-215		
SO_4:				
	Sacramento R.	6.6-14 mg/l	0-26	nns
	Colusa BDC	58-257		
	Cache Creek	about 11		
Cl:	Sacramento R.	2.6-7.1 mg/l		nns
	Colusa BDC	22-104	3.8-76	
	Cache Creek	9.9-35		
NO_3:				
	Sacramento R. & Cache Creek	0.2-1.3 mg/l		nns
	Colusa BDC	2.2-6.5	0.5-23	
B:	Sacramento R.	0-0.1 mg/l		nns
	Colusa BDC	0.2-0.4	0-2.0	
	Cache Creek	about 1.1		

1. from Hydrology Data: 1969, Volume II: Northeastern California, Bulletin No. 130-69, Calif. Dept. of Water Resources, May 1971.
2. from Ref. 6.
3. from Ref. 13, for surface waters only.

to very hard. The ground waters also vary from being hard to very hard. Most of the higher values in the reported range of groundwater quality factors occur in the northern Colusa County area.

b. Soils

The soils of Site 5 represent one typical complex mix of the azonal soils of mountains and geologically young mountain valleys. They range from lithosols (or stoney soils) of the steep sloped uplands to the regosols (recently deposited alluvium, windblown, etc.). The soils of the floodplains, alluvial fans, and the gentle rolling slopes are generally classified as loamy or clayey warm dry regosols, brown, or alluvial soils (Ref. 2). The mean annual soil temperature is over 47°F. Pedogenic horizons are generally absent and there tends to be a regular decrease in organic content with increasing depth. There is, however, in Site 5 significant evidence of the development toward the chestnut and brown (steppe) and prairie types of chernozemic soils with the development of distinct stratification between deep darker topsoils and lighter colored subsoils and substratum reflecting parent materials (background reference Section A-3c, and Refs. 10c,10e,10i, and 10j.)

The soils that have developed in the sedimentary alluvium of the nearly level alluvial fans and floodplains are very deep and generally moderately to well drained. Poor drainage is associated with mixed sedimentary alluvium. Predominant topsoils consist of mildly to moderately alkaline grayish brown silty clays and silty clay loams, mildly alkaline dark gray clays and calcareous grayish brown very fine sandy loams, neutral grayish brown silty loams and silty clay loams, slightly acid pale brown silty loams and grayish brown silty clay loams and dark gray clays, and medium acid gray clays. Their subsoils consist of moderately alkaline grayish brown and dark grayish brown silty clays and dark gray clays, mildly alkaline light yellowish brown to dense yellow brown clay loams, mildly alkaline mottled light yellow brown silty clay loams and calcareous gray clays, and neutral grayish brown silty loams. Their substratum range from moderately alkaline calcareous pale brown silty clay loams and silty clays, mottled pale olive loams and gray clays, mottled olive gray clays, light yellowish brown sandy loams, and calcareous mottled silty clay loams; to mildly alkaline pale brown silty loams; to calcareous strongly cemented clays. The predominant soil associations in this soil grouping, in order of importance, are the Brentwood-Yolo-Sycamore, Brentwood-Yolo, Marvin-Rincon, Capay-Clear Lake-Sacramento, Stockton-Sacramento, Marvin-Rincon-Tehama, and Capay-Clear Lake associations. They cover about 41 percent of Site 5, and predominate more or less in sub-areas 5.4, 5.5, and 5.6.

The soils of gentle rolling to hilly slopes vary generally from moderately deep to deep soils formed in softly consolidated sediments to shallow soils with dense claypan subsoils over mixed sedimentary alluvium. The erosion hazard varies from moderate to slight. The predominant topsoils consist of medium acid grayish brown clays, strongly acid light brown gravelly loams, and slightly acid brown loams. Their subsoils consist of moderately alkaline calcareous olive gray clays, and medium acid strong brown clays and strongly acid gravelly red clays. The associated substratum ranges from moderately alkaline calcareous olive gray softly consolidated sandstones to neutral reddish yellow very gravelly clays and yellowish brown clay loams. The predominant soil associations in this soil grouping, in order of importance, are the Sehorn-Balcom, and the Corning-Hillgate associations. They cover about 18 percent of Site 5 and are concentrated primarily in sub-area 5.3.

The soils of steep to very steep sloped uplands and steep terraces consist of shallow to moderate deep soils and develop in softly consolidated sediments, on hard sandstone and shale, and in mixed sedimentary alluvium. They are usually well drained. The erosion hazard ranges from slight to very high. The predominant topsoils range from medium acid brown clay loams, to slightly acid light brownish gray rocky loams and brown gravelly loams. Their subsoils range from medium acid yellowish brown clays, to neutral pale brown stony loams and yellowish red gravelly clays. The dominant substratum is composed of mildly alkaline pale olive very fine sandstones, neutral light brownish gray shattered shale, and reddish brown very gravelly loams. The predominant soil associations in this soil grouping, in order of importance, are the Dibble-Millsholm and Positas associations. They cover about 22 percent of Site 5 and predominate in sub-area 5.1.

More detailed soil information is presented in Tables V-A-2, 3, 9, and 10.

c. Climatology and Meterology

The climate of Site 5 is characterized by dry, warm to hot summers with moderately cool and moist winters. Air temperatures range in January from about 44°F to lows of about 40°F at the northern end of subarea 18.1. In July, the average temperatures range from 72°F on the west to 77°F on the east. Mean annual precipitation, pan evaporation, potential evapotranspiration, and vegetative requirements for the six sub-areas of the Site are shown in the following (from Table V-A-4):

Mean Annual	Site 5 Sub-Areas 5.1	5.2	5.3	5.4	5.5	5.6
Precipitation	22.0"	18.0"	18.0"	16.0"	16.0"	17.0"
Pan Evaporation	67.2	58.8	63.6	69.9	69.0	69.9
Potential Evapotranspiration	47.0	41.1	44.6	49.2	49.2	49.2
Vegetative Requirement	35.4	31.0	34.2	39.3	39.3	39.0

About 74 percent of the mean annual precipitation is concentrated in the months of November through March in the western part of the Site and increases to 87 percent in the eastern part. About 69 percent of the mean annual pan evaporation occurs between May and September. Mean annual evapotranspiration from non-irrigated areas ranges from just under 15 inches in the eastern half of the Site to a high of about 20 inches in the westernmost edge of the Site Area. The average length of the growing season ranges from just over 300 days without a killing frost east of the Sacramento River to just under 240 days in the westernmost edge of the Site. Mean annual sunshine is about 3200 to 3400 hours per year. (Refs. 2, 6, and 10j.)

Summary of Air Quality Conditions: It is estimated that Site 5 currently experience moderately high high-hour oxident level frequencies, about 20 to 40 days per year, in the flatlands of the Sacramento Valley (Ref. 142.) In the uplands and more remote areas, these experiences are estimated to range between 10 and 25 days per year where oxidant levels are at or above 0.10 ppm. Background discussion for this has been presented in Section A-3d. The Site Area's proximity to Sacramento to the southeast together with the projection of current development rates would indicate a general increase in these experiences with higher oxidant levels. The degree to which current air pollution control programs, Federal, state, and local, will affect this in the immediate future period is uncertain.

3 - Environmental Setting Without the Project: Ecological

a. Vegetative Cover

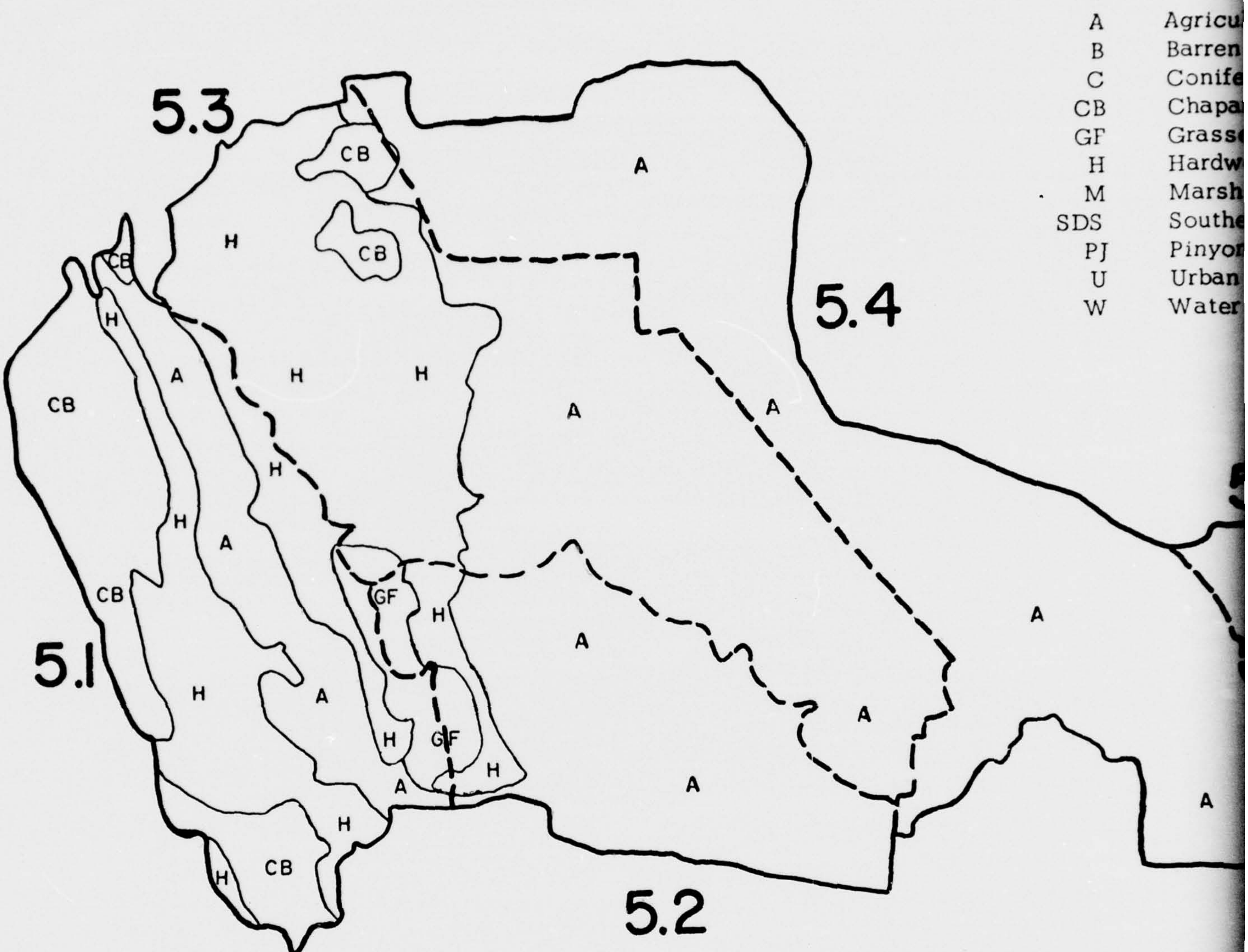
Site 5 supports four major vegetative cover types: agricultural, grasses and forbs, hardwoods (oak-woodlands) and chaparral (Fig. V-C-6). Site 5 also includes a portion of the Sacramento River which supports, in some stretches, dense riparian growth. Cache Creek and some of the small streams of the Site 5 support limited riparian growth.

Over one half of Site 5 is presently in agrarian use. Part of the major rice growing area in California's Central Valley includes sub-area 5.6. Canals and drainage ditches support cattails (Typha sp.), bulrushes (Scirpus sp.), and an occasional willow (Salix sp.), as well as an assemblage of grass species. Native and introduced vegetation such as sweet clover (Melilotus sp.), sweet fennel (Foeniculum vulgare), tumbleweeds (Amaranthus albus), thistle (Circium sp.), and various grasses are found in the "weedy" edges of some fields and along roadsides.

The section of the Sacramento River that flows between sub-areas 5.5 and 5.6 has extensive riparian vegetation in some areas along its levees (see Table V-C-2). The eastern berm and levee have long stretches of valley oak, cottonwoods, black walnut, sycamore, willow, grape, etc., forming dense riparian vegetation. The west levee and berm support some vegetation such as a few cottonwoods, but for the most part the levees have been cleared of large trees and bushes. Some areas are lined with rock. Valley oaks, singly or in groves, are found on the land outside the levees.

Sub-area 5.5 is also agrarian with valley oaks singly or in groves in the cultivated fields. Riparian vegetation is dense in some areas along the river, such as Grey's Bend. Canals are lined with cattails, bulrush, willows and grasses.

Sub-area 5.4 is primarily dry or irrigated pasture. Canals, ditches, and "weedy" edges of fields are similar in vegetation to those similar areas previously described. Cache Creek in this area is ephemeral, but supports riparian vegetation in the form of willows, elderberry (Sambucus mexicana), cottonwoods, and tamarisk. Large valley oaks are found in the vicinity of Cache Creek in increasing numbers as the creek is approached. They are, however, not found in the creek bed or on the banks.



5.3
5.4
5.1
5.2
CB
H
A
GF
A Agricu
B Barren
C Conife
CB Chapa
GF Grass
H Hardw
M Marsh
SDS Southe
PJ Pinyon
U Urban
W Water

2

Figure V-C-6

EXISTING VEGETATIVE COVER IN SITE 5

COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous forest
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

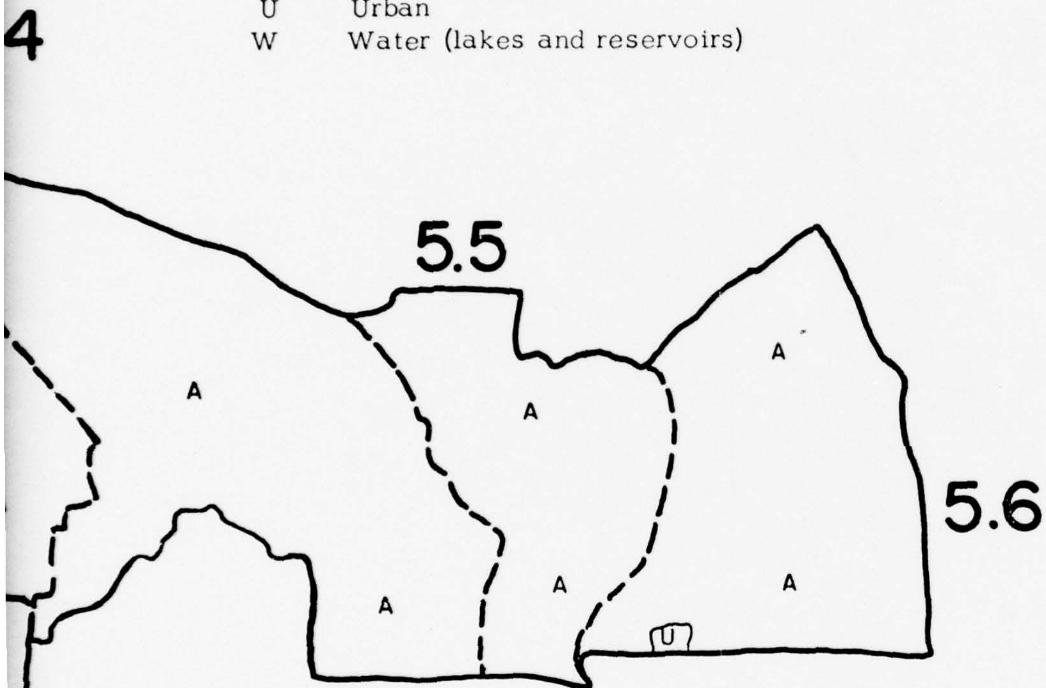


Table V-C-2

DOMINANT NATIVE VEGETATION OF STUDY SITE AREA 5

Vegetative Cover Type	Scientific Name	Common Name
Grasses and forbs	Bromus spp.	Chess
	Festuca spp.	Fescue
	Avena spp.	Oats
Hardwood (oak woodland)	Pinus sabiniana	Digger pine
	Quercus lobata	Valley oak
	Q. douglasii	Blue oak
	Q. wislizenii	Interior live oak
	Q. agrifolia	Coast live oak
	Q. dumosa	Scrub oak
	Q. chrysolepis	Canyon oak
	Aesculus californica	California buckeye
	Rhamnus californica ssp. tomentella	California coffeeberry
	Cercis occidentalis	Redbud
	Umbellularia californica	California bay
	Eriodictyon californicum	Yerba santa
Chaparral	Adenostoma fasciculatum	Chamise
	Heteromeles arbutifolia	Toyon
	Rhamnus californica ssp. tomentella	California coffeeberry
	Quercus dumosa	Scrub oak
	Ceanothus spp.	Ceanothus
	Arctostaphylos spp.	Manzanita
	Cercocarpus betuloides	Mountain mahogany
Riparian	Plantanus racemosa	Sycamore
	Populus fremontii	Cottonwood
	Salix sp.	Willow
	Salix hindsiana	Sandbar willow
	Vitis californicus	Wild grape
	Juglans hindsii	Black walnut
	Fraxinus latifolia	Ash
	Rosa californica	Rose
	Sambucus mexicana	Elderberry
	Tamarix	Tamarisk

The southeastern portion of sub-area 5.3 encompasses the Dunnigan Hills. The northern reaches of the Hills support almond orchards while the central and southern portions are dry pasture and dry farmed. Washes and stream beds possess vegetation similar to the vegetation at higher elevations to the west in the Capay Hills (chamise, toyon, live oak, and California buckeye). Sub-area 5.2 is also agrarian with canal, ditch, roadside, and "weedy" edge vegetation as previously described.

The Capay Hills which form the border between sub-areas 5.3, 5.2 and 5.1 support oak grasslands and grasses and forbs vegetative cover types. The grasses are various species of Bromus, Festuca, and Avena. Live oak trees are irregularly distributed over the area with gulleys, ravines and north slopes tending to be oak parklands (oaks and grasses - little underbrush) and south slopes tending to have a few or no oak trees.

The Capay Valley (sub-area 5.1) floor is devoted to orchard crops. The Capay Hills to the northeast are covered with oak parklands while to the southwest, Blue Ridge with lower elevations, is oak woodland and at higher elevations is chaparral. Part of the higher elevations of Blue Ridge burned during a recent fire. The chaparral areas burned, while the lower elevation oak-woodlands appear to be scorched.

Oak woodland vegetation is found along the creeks which flow across the Capay Valley floor to Cache Creek. Riparian vegetation on Cache Creek is composed of live oak, willow, tamarisk, and digger pine.

The upper reaches of Capay Valley (northwest of Rumsey) support chaparral and oak woodlands (with digger pine) on both north and south slopes. Almost all the species listed as dominant vegetation in the oak woodland and chaparral vegetative cover types are found together in this area. Cache Creek at this location supports digger pine, cottonwoods, willow, manzanita, live oak, and yerba santa as riparian vegetation.

A listing of rare, endangered, and possibly extinct plants whose distributions include Site 5 may be found below.

Species	Local Habitat	Plant Community
Fritillaria pluriflora (Adobe lily)	Adobe soil of interior foothills below 1,500 feet	Foothill woodland

Species	Local Habitat	Plant Community
Hesperolinon breweri (a flax)	Inner coast range grassy or brush slopes, partly shaded at least partly on serpentine	Foothill woodland Chaparral
Cordylanthus palmatus (a bird's-beak)	Alkaline overflow lands	Valley grasslands

b. Fish and Wildlife

Fisheries: A major warmwater and anadromous fishery exists in the Sacramento River from Elkhorn Ferry north to Knights Landing. Other fisheries areas include the Yolo Bypass and Cache Creek in Capay Valley and numerous irrigation laterals that transverse the farm land in Yolo County. Cache Creek waters are extensively used for irrigation purposes and the creek very seldom flows in its lower reaches outside of the Capay Valley. Small irrigation laterals are frequently drained in the winter when water is not needed for agricultural purposes.

Anadromous Fish. The main branch of the Sacramento River is an important migratory route for chinook salmon, steelhead, and American shad. An estimated 260,000 chinook (King) salmon spawners travel the Sacramento River with a yield of 0.10 fish/angler-day. Ten thousand steelhead spawn in the main stem of the Sacramento River with a yield to fishermen of 0.31 fish per angler-day.

The number of spawning stock chinook salmon in the main stem of the Sacramento River from 1965 to 1971 are listed below.

Year	Spawning Stock
1971	85,000
1970	74,654
1969	153,252
1968	110,229
1967	91,690
1966	114,981
1965	103,376

Warmwater Fishery. A premium warmwater fishery exists in the Sacramento River and the adjacent Yolo Bypass. Catfish, black bass,

sunfish, and striped bass are the most important game species of the area. Non-game fish, such as carp, squawfish, hitch, and suckers are also present.

Wildlife: There are four basic wildlife habitats represented in Site 5. They are: 1) the riparian vegetation found on levees and berms of the Sacramento River; 2) the open water and marshes of the Yolo Bypass; 3) the agricultural land found west of the Yolo Bypass and east of the Capay Valley; and 4) the chaparral-oak woodland found in the mountains along Blue Ridge. Wildlife and fish species whose distribution include Area 5 are listed in Chapter K , while those species observed during field investigations are listed in Table V-C-3.

Big Game. The inner coast range in Site 5 is a "medium grade" deer range with densities up to 10 to 30 deers per square mile. Forage conditions have improved in the last several years due to late spring rains. Brush manipulation (increasing the amount of young growth by removing strips of old brush) has been suggested to improve the range in western Yolo County. Hunter kill was down in the 1970 and 1971 seasons over the previous five-year average. The lower hunter success was attributed to a decrease in hunting pressure. The depredation (animals killed because they are inflicting damage on local crops) kill has gone up from 33 in 1970 to 50 in 1971, but it is still below the five-year average. The chaparral-oak woodlands have reached their carrying capacities, although range improvement could increase carrying capacities. (Ref. 32.)

Tule elk were historically found in the Sacramento-San Joaquin Valleys and foothill areas. Now they are present only in localized herds. One herd is found adjacent to the northwest boundary of Site 5, in the Fiske Creek area. In 1965 the herd had a population of 80 to 100 individuals. (Ref. 32.)

Bear probably occur in the higher elevations of the inner coast range, on Blue Ridge.

Upland Game. The rice land and irrigated pastures of Yolo and Colusa Counties are prime pheasant areas. Densities range from 64 to 320 per square mile, which is very high. For the previous several years, both Yolo and Colusa Counties have been rated in the top 10 percent of the state's total pheasant bag. (Ref. 32.)

California valley quail occur on the levees and berms of the Sacramento River. Brushy ravine areas in the Capay Valley and inner coast range are also important quail areas. Clean farming practices were

Table V-C-3

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS ON OCTOBER 13, 1972 OF WASTEWATER LAND APPLICATION STUDY SITE 5

Birds	Mammals
Pied-billed grebe	Muskrat (Rk)
Great blue heron	Striped skunk (Rk)
Widgeon	Ground squirrel
Pintails	Black tailed jackrabbit
Turkey vulture	Columbia blacktail deer
Marsh hawk	
American kestrel	**Reptiles**
Red-tailed hawk	
California valley quail	Garter snake
Ring-necked pheasant	
American coot	**Fish**
Snowy plover	
Killdeer	Common carp
Common snipe	Bluegill
American avocet	
Back-necked stilt	
Gull species (juvenile)	
Mourning dove	
Belted kingfisher	
Red-shafted flicker	
California acorn woodpecker	
Yellow-billed magpie	
Scrub jay	
Common crow	
Mockingbird	
Loggerhead shrike	
Meadowlark	
Red-winged blackbird	
Lesser goldfinch	
House finch	
White crowned sparrow	

(Rk) = Road kill

observed in northern Yolo and southern Colusa Counties, particularly around orchards. This reduces quail (and other animal) habitat that could easily be produced by leaving weedy edges and brush piles. Hunters bagged about 11,100 birds in Yolo County in 1970 according to postcard surveys which are used to estimate hunter success. They averaged about four birds per hunter.

Some tree squirrels are taken by hunters in Yolo County. The greatest concentrations probably occur in the cottonwood and oak trees bordering waterways, and in the oak woodland on the inner coast range.

Brush rabbits occur commonly in the same habitat with California quail. Jackrabbits are common in the open fields of the Dunnigan Hills and in irrigated cropland in Yolo County.

Mourning doves are common in the agricultural lands and foothills of the Capay Valley. In good years, densities of 320 per square mile are common.

Waterfowl. The Yolo Bypass is an important concentration point for wintering waterfowl, especially after flooding occurs. Yolo County consistently rates in the top ten counties for hunter kill of waterfowl. Approximately 1,000,000 ducks annually use the Yolo Bypass north of Interstate 80 when it is flooded during a wet year. In a dry year this figure may be as low as 100,000 birds. About 25,000 to 40,000 geese annually use the Yolo Bypass.

Non-game Wildlife. The marshes in the Yolo Bypass support a myriad of non-game birds and wildlife. Shorebirds are common on the mudflats and shallow water areas. Long-legged wading birds, such as herons and egrets, are common in deeper water areas. Muskrats, raccoons, and weasels are common mammals found in marshes and open water.

The oxidation ponds of the Woodland Sewage Treatment Plant are popular feeding areas for shorebirds.

The riparian zones support populations of songbirds (warblers, mockingbirds, finches, and sparrows) and mammals such as raccoons, foxes, opossums, and mice.

Rare and Endangered Species: There are fifteen animal species that are thought or known to occur in Site 5 that are listed as rare or endangered. These are listed in Table V-C-4 and in the appendix (Chapter K).

Table V-C-4

RARE AND ENDANGERED SPECIES IN SITE 5

Common Name	Status	Occurrence
Fish		
White sturgeon	U	x
Thicktail chub	U	x
Sacramento perch	U	x
Reptiles		
Alameda striped racer	R	x
Birds		
Wood ibis	P	x
Aleutian Canada goose	E	*
Tule white-fronted goose	E	*
Red-bellied red-shouldered hawk	U	*
Ferruginous hawk	U	x
Southern bald eagle	E	*
American osprey	U	x
Prairie falcon	U	*
American peregrine falcon	R	*
Greater sandhill crane	R	x
Mountain plover	U	*
Alaskan short-billed dowitcher	U	*
California yellow-billed cuckoo	R	*
Yakutat fox sparrow	U	*

E Endangered

R Rare

P Peripheral

U Status uncertain

x This species or subspecies definitely or probably occurs on the wastewater management area.

* Occurrence of this species or subspecies on the wastewater management area is uncertain or questionable.

<u>Fish</u>. White sturgeon occur throughout the Sacramento-San Joaquin Delta and in the Sacramento River. Sturgeon were once very abundant, but now numbers have been reduced. They are easily over-fished.

The Sacramento perch was once very abundant in the Sacramento-San Joaquin River system, but since the introduction of other centrarchids (particularly black bass and sunfish), Sacramento perch populations have declined. Perch populations probably will never occur near their historical abundance as long as other centrarchids are present.

<u>Reptiles</u>. The Alameda striped racer is listed by Stebbins (1966) to occur throughout most of northern and Central California. Habitat reduction, particularly in the eastern parts of the San Francisco Bay Area, is the most critical factor leading to its decline. Its habitat includes chaparral, open woodland, and grassland.

<u>Birds</u>. The tule white-fronted goose and the Aleutian Canada goose are winter migrants to California. Fallow grain fields are important resting areas. Geese feed mainly on young grasses, forbs, and on grain.

The raptorial birds (birds of prey) are faced with serious problems of survival. Persistent pesticides (especially DDT) have contaminated their food chains. This results in the production of thin shelled eggs which break before hatching. Other reasons leading to the decline in some raptorial birds include shooting by poachers and human encroachment on nesting and feeding areas. The American peregrine falcon has been taken illegally by falconers for many years.

Habitat reduction has been responsible for the reduced numbers of many rare or endangered animals. The yellow-billed cuckoo utilizes dense riparian growth for cover. Clearing of riparian growth and land development have reduced population of this bird. The wood ibis winters in southern California and is occasionally found as far north as Central California. Its habitat also consists of marshes, lagoons, and ponds.

The sandhill crane is a regular winter visitor to Central California, preferring prairies, grassland, and fallow grain fields. Some of these birds are mistakenly shot by waterfowl hunters each year. The Central Valley population is about 2,000 to 3,000 birds each winter.

The Alaskan short-billed dowitcher is a winter visitor to California. It utilizes marshes and particularly mudflats for feeding.

All those species whose primary habitats are marshes and wetlands have suffered habitat reductions as these areas have been drained and filled.

Wildlife Diseases: The great diversity of habitats for wildlife in Site 5, and the existing and proposed complexity of land uses necessitates consideration of this region as sub-areas (Refs. 120, 121).

Sub-Area 5.1. The hills surrounding Capay Valley and particularly Blue Ridge on the west side have relatively high populations of deer. This is indicated by the large number of depredation permits issued to the ranchers to kill deer that invade the valley almond orchards. This deer herd suffers occasional high losses from foot rot, a disease caused by the anaerobic bacterial species *Spherophorus necrophorus*. The organism thrives in mud contaminated by droppings. Deer walk through the mud which later dries between the hoofs causing the tissue to crack and the bacteria gain access through fissures in the tissues. Deer lick their infected feet and bacteria enter abraded tissues of the mouth or throat. Abscesses develop and in this kind of disease it is known as calf diphtheria. The infection can spread from either the feet or the mouth and throat to the internal organs with development of large abscesses and death results.

During drought years there are high mortality rates from foot rot. The seasonal incidence of foot rot is during the late summer. The combination of a dry year and a hot dry summer in the interior ranges results in crowding of deer around the remaining available water or mud holes, thereby, causing heavy contamination of the scarce sources of water. The deer eat dry grass and foxtails may work their way into the tissues of the feet or mouth allowing entrance of the pathogenic bacteria and infection ensues.

Wastewater application to the hills surrounding Capay Valley would improve the oak-chaparral-grass deer range and thus contribute to the health of the animals. Summer application would negate the effects of a dry year and create a positive control on the outbreaks of foot rot in deer. Development of the reservoir in Capay Valley would provide water in this otherwise xeric region and therefore have a beneficial impact on the deer herd.

Sub-areas 5.2 and 5.3. The same situation as far as foot rot in deer is concerned would apply but to a lesser extent than in sub-area 5.1.

The development of pasture lands adjacent to the deer ranges would create an opportunity for the occurrence of the internal parasites of stomach worm, lungworm, and liver fluke. Liver fluke is not much of a problem at present in these areas. However, with more moisture, and the opportunities for increases in snails and sheep (intermediate hosts), undoubtedly there would be a much higher incidence of liver fluke. Management of the lands and the application of wastewater must be controlled to minimize environmental conditions conducive to internal parasite requirements.

Sub-area 5.4. The rice lands within this sub-area support a good population of pheasants (about one per two acres). The pheasant is a rather unique species of wildlife in respect to disease conditions in that no significant mortality from parasites or infectious diseases occurs among the birds on agricultural lands. Application of wastewater to this sub-area would not change this status.

Portions of Sub-area 5.4 provide suitable habitat for waterfowl. Consequently, the two most important diseases of waterfowl pose problems that do and would continue to occur here. Botulism, as described for Site 4, is a sporadic condition during late summer among the ducks frequenting ponds in sub-area 5.4. Wastewater application could magnify the problem, but with controlled use of the water, the dangers of botulism could be overcome. The other disease is avian cholera in the winter among the waterfowl. This contagion is also amenable to control by use of adequate water management as indicated for Site 4.

Sub-area 5.5. The Yolo Bypass periodically is flooded in winter and attracts tremendous numbers of waterfowl. There is an extension of avian cholera from the Delta Islands northward to the Yolo Bypass as the flood waters recede. If wastewater could be used to maintain water levels in the Yolo Bypass for longer periods of time, the losses to avian cholera could be diminished, although this procedure would not allow time for soil preparation in farming operations.

Sub-area 5.6. Both pheasants and waterfowl live in this area. Neither botulism nor avian cholera has been a threat to wildlife here. It is not anticipated that the application of wastewater will change the current situation.

Fish Diseases and Parasites: The affliction of fish species found in Site 5 will be essentially the same as those found in Site 4. Refer to the discussion of fish diseases and parasites found in Section B-3b.

c. Ecological Systems

With the exception of the inner coast range, the Yolo Bypass, and the berms and levees of the Sacramento River, Site 5 is essentially in agriculture. Important consideration must be given to the critical riparian and marsh habitat available in Site 5.

Riparian vegetation is common on the Sacramento River levees and berms except where areas have been cleared by channelization or bank stabilization. Most of the vegetation consists of mixtures of trees, brush, and annual and perennial grasses and forbs. These areas support the most diversified and abundant array of wildlife of any habitat in Site 5.

Song birds are common, raptorial birds nest in the higher trees, and the understory supports small mammals and gamebirds.

When this variety of vegetation is reduced to one or two species, the diversity of wildlife is reduced proportionally with the loss of vegetation. The few animal species that remain are those able to utilize the one or two plant species available. An example would be to eliminate trees and shrubs from a levee and leave only the annual grasses and forbs. This eliminates those animal species dependent upon trees and shrubs for food and cover.

Good quality marsh land is critical habitat wherever it is found and in whatever quantity. The Yolo Bypass represents relatively good marsh habitat when it is flooded. Wintering ducks use the Yolo Bypass for resting areas. The tules and bulrushes provide food and cover for these birds.

Resident water and shorebirds also depend upon the Yolo Bypass for habitat. The common coot is abundant. Dowitchers and plovers feed in the mudflats and shallow water areas. Snowy egrets and great blue herons also feed in the shallow water areas. Muskrat, raccoon, and mink are some mammals dependent upon the marsh.

"Weedy" edges of agricultural fields are important habitat for birds and small mammals. Weed edges left around fields provide food and cover for quail, pheasant, rabbits and song birds. The presence of this wildlife habitat rests solely with the practices of the local landowner.

d. Recreational Resources

Site 5 was estimated to have a gross recreational user potential of 109 million visitor days per year. Although actual use figures are

unavailable, the Yolo Bypass, Capay Valley, and Sacramento River are all heavily used by recreationists.

The primary recreational activities include fishing (salmon, shad, striped bass, steelhead, catfish, crappie, bass), hunting (ducks, geese, pheasant, deer, quail, rabbits, doves), camping, hiking, horseback riding, picnicking, swimming, bicycling and sightseeing.

The Yolo Bypass offers an extremely good opportunity for wildlife observation and hunting due to the large numbers of shore and marsh land wildfowl and other wildlife that inhabit the area for all or part of the year. The Sacramento River is extensively used for fishing, as there are sizable populations of game fish throughout the year and boat access is excellent. Capay Valley provides an especially popular setting for sightseeing outings by horseback, bicycle and automobile travelers. The unusual combination of distinct geologic, geographic and floral features present in the valley provide a scenic experience particularly popular in the spring and fall.

Present Public Facilities: The U.S. Forest Service and the U.S. Bureau of Land Management each own and maintain campsites located adjacent to Site 5. Both are located on the western slopes of Blue Ridge just outside of Capay Valley and contain only primitive camping and picnicking facilities. There is also a Bureau of Land Management riding and hiking trail extending along the entire western Yolo County line, connecting Putah Creek on the south with Davis Creek on the north. The remaining public recreation sites are county owned or maintained.

Esparto Park, a community park within the town of Esparto, offers picnicking and playground opportunities for local residents. An angling access site at Knights Landing is also county maintained, with minimal parking and restroom facilities. Yolo County owns a 22-acre picnic area on Cache Creek immediately east of Guinda. Again, facilities are minimal with picnic tables and restroom facilities present.

Cache Creek and the Sacramento River provide kayaking, canoeing and rafting opportunities that are not maintained by any specific public agency. The American Whitewater Affiliation (AWA) has classified rivers in terms of the difficulty of the river for boating. Their classifications are: I - very easy; II - easy; III - medium; IV - difficult; V - very difficult; VI - extremely difficult. The AWA is a private, non-profit organization of persons interested in canoeing, kayaking, and rafting. The AWA has designated Cache Creek, from the Colusa County line to Capay, as being a kayaking waterway with reaches of Class I, II, and

III difficulty. Approximately 2,000 to 5,000 man-days per year of boating voyage has been estimated for these reaches. The Sacramento River, from Red Bluff to Sacramento, is considered to be a Class I waterway according to the AWA; it receives from 10,000 to 25,000 man-days of boating use per year (Ref. 30).

Present Private Facilities: Privately managed recreation opportunities are primarily associated with hunting and fishing. There are three marinas on the Sacramento River that offer accommodations to both fishermen and pleasure boaters. A list of their facilities follows.

	Launching	Berths	Mooring	Dry-Storage	Accommodations	Camping	Picnic	Trailer
Alamar Landing		x	x				x	
Rio Ramaza	x	x	x					
Joe's Place	x		x					x

Private hunting clubs are located throughout Site 5, but because licenses are not required of all such clubs, complete records of locations and size are not immediately available. Private licensed pheasant clubs are especially prevalent in the rice growing areas of the Sacramento River basin and the field crop areas north of Dunnigan. Two clubs were identified along the county line north of Dunnigan: the Oak Hills Hunting Club (400 acres) and the County Line Club (714 acres) (Ref. 35). Many of the rice fields located in the Sacramento and Sutter County sections of Site 5 are leased after harvest to private groups for flooding and use as waterfowl hunting clubs. Private deer hunting clubs also adjoin the Bureau of Land Management lands in the foothills east of Capay Valley. Detailed information on these clubs is not available.

There are several other private facilities worth mentioning. A target pistol and rifle range is located just east of Woodland on County Road 102. The Yolo Fliers Club, an 18-hole private golf course, is located immediately west of Woodland at the junction of County Roads 94-A and 22.

Hunter and Angler Use: California Department of Fish and Game 1970 hunter survey and 1972 wildlife management unit reports provide the limited hunter use information available for Site 5. The following hunter survey statistics were compiled by county based on a two percent post-season mail inquiry and are not specific to Site 5.

1970 Hunter Survey - Yolo County*

	Bag	Hunters
Pheasant	47,400	16,700
Quail	11,100	2,400
Dove	77,200	6,200
Pigeon	1,300	200
Jackrabbit	42,800	3,600
Cottontail	1,800	600
Tree squirrel	1,000	400
Ducks	192,800	8,100
Geese	12,200	3,900
Jacksnipe	600	100
Coots	31,300	1,600
Deer	700	2,700

* From unpublished records of California Department of Fish and Game, Sacramento.

Wildlife management unit reports are more specific to the area. Records for the Capay deer herd which frequents the foothills surrounding Capay Valley indicate an average yearly buck kill of 405 over the last three years. In addition, an average of 85 antlerless deer were taken in special depredation hunts over the same time span. The 1971 total kill of 319 was down 38 percent from the previous 5-year average, the decrease being attributed primarily to a decrease in hunting pressure (Ref. 34).

Fishing figures for the entire Sacramento River are available, reflecting the size of the fishery passing along the river's main stem. Approximately 260,000 king salmon migrate up the river; the yield being one fish per 10 angler days. Steelhead runs of up to 10,000 per year also travel the Sacramento River; the yield being 0.31 fish per angler day (Ref. 32).

Open Space: Because Site 5 lies almost entirely within Yolo County, it is that county's open space policy that most affects any development plans within the study area. A new Open Space Element to the Yolo County General Plan was adopted by the County Board of Supervisors in June of 1972. Six separate and individual land attributes deserving of open space status are discussed in the Element. Agricultural land, which includes over 90 percent of the county's surface area, is actively maintained under Williamson Act provisions for the commercial production of food and fibre. Site 5 reflects this domainance of agricultural lands, with the only large exclusion being urban and institutional lands at Woodland, Dunnigan, Esparto, Brooks and Guinda.

The remaining five open space categories and lands include relatively small parcels of land. Their designations and areas of influence are as follows:

1. Natural Resources Land - This category is established primarily to protect the prime soils area and sand and gravel resources found through the county. Prime soils occupy the lowland basins of Capay Valley, Hungry Hollow and the entire Sacramento basin east of the Dunnigan Hills. Sand and gravel deposits are restricted to the bed of Cache Creek and the lower reaches of Buckeye and Oat Creeks.

2. Watershed and Ground Water Recharge Land - These areas are conserved to maintain the quality and quantity of waters available to Yolo County. The higher slopes of Blue Ridge and the Capay Hills are watershed.

3. Wildlife Habitat - These lands are maintained as unusually valuable or necessary for the preservation of the state's wildlife resources. The foothills around Capay Valley, undeveloped Sacramento River frontage, and Yolo Bypass farmlands are all considered important wildlife habitat.

4. Recreation Land - This category includes any state, regional, county or local lands open to public recreation. Recreation areas within Site 5 are discussed in the Present Public Facilities section of this report (Ref. 106)

Future Public Facilities: There is a wide assortment of federal, state, county and regional recreation development planned within Site 5. Most facilities are still in the planning stage, but several are being actively brought into existence.

The single state project is located on 100 acres of farmland just north of Woodland along Road 18-c. The land was recently donated to the state by Spreckels Sugar Company for development as a state park. The site will offer picnic and other day use facilities (Ref. 25). Federal involvement in Site 5 is limited to a planned joint recreational development of Oat Reservoir five miles south of Dunnigan. The reservoir itself has not yet been constructed, but is scheduled to be a part of the West Side Canal System proposed by the Bureau of Reclamation. The 200-acre regional park site is expected to include picnicking, swimming, boating, fishing, riding, water skiing and hiking use, developed by the federal government and operated and maintained by Yolo County (Ref. 107).

Yolo County has several independent recreation ventures in the planning stage. A reservoir and 70-acre park is being considered for Palmer Canyon just west of Brooks. "No wake" boating, swimming, hiking and picniking will be offered at the foothill site. At present no development has taken place in Palmer Canyon. The initial steps of acquisition have, however, taken place in regards to two other county recreation sites. Elkhorn Regional Park (86 acres) along the west bank of the Sacramento River immediately south of Interstate 5 is being purchased and will provide boat launching, camping, and picnicking. An additional angling access site along the Sacramento River at the Yolo Bypass (Fremont Weir area) is being developed on five acres of Department of Fish and Game managed land. In addition, Yolo County plans to improve the present angling access area at Knights Landing by providing more parking, upgrading restroom facilities and including picnic tables. A final county proposal, a riding and hiking trail along the Sacramento River, is actually part of the regional system of trails being considered by the U.S. Army Corps of Engineers along numerous California inland waterways. It, at present, is not being actively developed (Ref. 107).

The Sacramento Regional Area Planning Commission has proposed additional riding and hiking trails and a regional bikeway for Site 5 that are not included in the Yolo County recreation plan. The riding and hiking trails would transverse the western county line, the entire length of Cache Creek, the length of the Sacramento River within the study area, and Interstate 5 highway from the Sacramento River to just east of Woodland. The regional bikeway would also parallel both sides of the Sacramento River and Interstate 5 highway from the Sacramento River to Woodland, but would continue through Woodland along State Highway 16 through Capay Valley and beyond the study area boundary (Ref. 83). A final regional recreation facility is now being developed by Sacramento County on the banks of the Sacramento River just north of Interstate 5 bridge. The site is a boat launching ramp with parking and restroom facilities already present.

e. Protected Waterways Evaluations

The following waterways are listed in the California Protected Waterways Plan, 1971.

The Sacramento River is classified as a premium (Class I) salmon, steelhead, striped bass, American shad and warmwater fishery. The Sacramento River has Class I riparian land in the extraordinary wildlife waterways evaluation. The Yolo Bypass is classified as a Class II marsh.

Cache Creek (Clear Lake to the town of Capay) has been classified as Class II scenic, fishery, wildlife and recreational waterway. It is also classified as having a Class I warmwater fishery.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

The archaeological potential for Site 5 is considered to be excellent in valley areas which have or which had a significant drainage system. Eight feasible archaeological sites have reportedly been identified but, however, not excavated (Ref. 11).

There are no historical landmarks of significant interest within Site 5. One minor one, the "Stephens Adobe," reportedly the only original adobe structure standing in Yolo County, was subsequently found to be located just outside the Site Area (Ref. 11). The structure was originally a granary built on the Spanish Land Grant, Canada de Capay, by Indians in 1850. Through several successive remodelings and conversions, the remains of the original structure are now incorporated into the 26-room Stephens Oakdale Ranch home. It is located just south of SR 16 between Esparto and Madison. Subsequent surveys also turned up the remnants of an original Wells Fargo bank building which has also been incorporated into a ranch home complex, this one also apparently located just outside the Site's limits.

b. Scenic Locations

The scenic character of Site 5 has been recognized by several state and regional agencies. The Sacramento River is classified as a Class I scenic waterway by the California Protected Waterways Plan. Cache Creek from Capay north to Clear Lake is classified as a Class II scenic, fishery, wildlife, and recreational waterway (see Section A-3e). That portion of SR 16 bordering Cache Creek from Capay west to beyond the boundary of the Study Area is scheduled for inclusion in the State Scenic Highway System (see Section A-3f). This stretch of SR 16 is also included in a regional scenic highway system being proposed by the Sacramento Regional Area Planning Commission. (Background references include Refs. 30, 39, 83, 106, and 107.)

Mention of the unique scenic character of the Dunnigan Hills and Hungry Hollow should also be made. In the spring when these sparsely vegetated hills and intervening valleys turn into a sea of green grass, their open and uncluttered expanse provides a welcome and restful contrast to the urban and rural development dominating most of the Sacramento Valley.

These scenic values are somewhat marred by the near universal appearance of roadside refuse scattered all along the edges of the roads and concentrated particularly at natural and specifically provided stopping and viewing areas.

Some idea of the scenic values of Site 5 can be anticipated from some of the views presented in Figures V-C-5a, 5b, and 5c.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact is the loss of vegetation, wildlife habitat, and wildlife on spoil areas.

Discussion: These matters have been covered in the discussion under Impact 13 for Site 4.

b. Impact 2

The second impact is the loss of wildlife species through loss of habitat (lands, vegetation) to project facilities.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to materials discussed for Site 4, Impact 5.

c. Impact 3

The third impact is the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to material discussed under Impact 12 for Site 4.

d. Impact 4

The fourth impact is the change in the micro-climate caused by the increased available moisture.

Discussion: A change in the plant and animal species will result with the maintenance of high humidities, especially over grassland and marsh areas. Increased moisture could result in the creation of conditions favorable to the growth of trees and bushes on the south facing mountain slopes which without the project were limited to north facing slopes because of higher temperature and lower soil moisture, on the south slopes. The beneficial or adverse impacts associated with humidity and soil moisture control need to be studied as a management tool. This is a major impact which may affect large land areas, but it will vary depending on site design.

Remedial, Protective and Mitigation Measures: This impact can be mitigated by the reduction in volume or frequency of application of incoming water. Impacts on fish and wildlife can be mitigated by management of the Site Area. Whether a change in the micro climate is adverse will depend on the change in animal species composition.

e. Impact 5

The fifth impact is the reduction in water quality of surface, subsurface and ground waters.

Discussion: The estimated quality of recovered water from Site 5 after wastewater application contains components that could possibly degrade the present water quality. This depends on where the recovered wastewater is disposed, the Sacramento River is one area that could be degraded and the degree must be determined from site specific design information. Among such components, those considered most significant are: total nitrogen (TN), total phosphorous (TP), and total dissolved solids (TDS). Current water quality conditions are illustrated for these values in table V-C-1.

The estimated quality of recoverable surface drainage wastewater will be about 400 to 1000 ppm TDS (which is generally higher than in the Sacramento River and Cache Creek, somewhat less so with respect to the Colusa Basin Drainage Canal); and 800 to 2000 ppm from groundwater and subsurface drainage of recoverable wastewater (definitely higher than existing conditions).

The upper limits of estimated recovery water TDS after wastewater application exceeds both surface and groundwater TDS levels at present. High TDS can inhibit the growth of some native plant species which are not salt tolerant. Different plant species tolerate different salinities, for example salt grass can tolerate salinities of 30,000 ppm. High TDS (1000 mg/l) is suspected of reducing reproductive capacities in some fish species such as the Centrarchids and Cyprinids (sunfish and carp).

Total nitrogen levels higher than 1 mg/l and phosphorous levels above 0.1mg/l generally encourage noticeable growths of algae. Waters which are rich in nitrogen and phosphorous can have algal "blooms" of such magnitude that fish and other aquatic animals may be killed by associated sags in dissolved oxygen (the oxygen is consumed both by the living and decomposing algae). The Central Valley Regional Water Quality Control Board is attempting to maintain total nitrogen at one part per million for

the Sacramento River arm of the Sacramento-San Joaquin Delta. Effects of dischargers upon maintenance of this standard are being reviewed individually (Ref. 26)

Drainage waters which are pumped out of fields into the Sacramento River, canals and sloughs will be diluted by existing water in the canal, river or sloughs. The introduced waters will add to the TDS, TN and TP load already carried by these waters, as well as adding an additional organic load contributed primarily by the agricultural lands. If flows in the Sacramento River are sufficiently high, the added load should not significantly impact the river. Pumping of recovered wastewater into dead-end sloughs may significantly reduce their water quality, because these areas naturally flush slowly and have lowered levels of dissolved oxygen. An example of this would be Grays Bend near Knights Landing.

Remedial, Protective and Mitigation Measures: Recovery canals should not be expected to have a sustaining sport fishery in areas of TDS greater than 1000 ppm unless a resistant fish is introduced and managed. Outfall locations should be limited to those areas with adequate mixing and dilution flows (as opposed to restricted channels and dead-end sloughs).

Monitoring of all outflows will be necessary to control the water quality of the effluent. High TDS, TN and TP waters may require pre- or post-application treatment to prevent degradation of surface or ground waters.

f. Impact 6

The sixth impact is the introduction and encouragement of diseases of wildlife and fish.

Discussion: Wastewater application in areas adjacent to deer range (Capay Valley) may change dry range into wet pasture; this would increase the prevalence of liver fluke and other internal parasites harmful to deer.

Ponding of wastewater where waterfowl populations are already present (Sacramento River rice lands, Yolo Bypass) might increase the threat of avian cholera and botulism, two diseases seasonally present among waterfowl populations in the Central Valley.

Remedial, Protective and Mitigation Measures: Effective management of wastewater flows into marshlands could diminish the threat of avian cholera and botulism by flushing the area.

Restrict wastewater application to areas away from known deer range.

Monitor wastewater pre- and post-application to prevent the introduction of disease organisms.

g. Impact 7

The seventh impact is the TDS buildup in soils that receive treated wastewater.

Discussion: Principally through evaporation, the salt content of soil moisture is raised during a growing season. Thus the soil becomes more salty in general, and in addition specific ions, such as boron, become more concentrated. These changes may have pronounced effects on vegetation. Essentially the most salt tolerant plants survive while others die. Because many birds and other animals are closely tied to specific species as a source of food, changes in plant species alter the animal community. On the other hand, some important animal food plants do well with greater salinity such as alkali bulrush. The particular use in an area has to be studied to determine limiting salt concentrations.

Remedial, Protective and Mitigation Measures: Water will be available during the non-growing season to flush the receiving soils. Periodic leaching of soils may be used as a management device for purposes of maintaining what are determined to be desirable plant communities.

h. Impact 8

The eighth impact is increased turbidity in streams and canals receiving wastewater.

Discussion: Increased channel flow in presently intermittent Cache, Buckeye, Oat and Bird Creeks may stimulate accelerated bank cutting and slumping along upper stream sections. Fill terraces along Cache Creek in northern Capay Valley are especially susceptible. Suspended loads will eventually enter into Colusa Basin Canal, Knights Landing Ridge Cut and the Sacramento River.

Present fisheries in upper Cache Creek, Sacramento River, Colusa Basin Canal and Knights Landing Ridge Cut would be adversely affected by an increase in turbidity, especially the feeding activities of sight-feeding fish species (black bass, striped bass, crappie, squawfish, steelhead).

Remedial, Protective and Mitigation Measures: Maintenance of wastewater inputs into Cache, Buckeye, Oat and Bird Creeks and their

tributaries below levels that would accelerate bank erosion.

Implementation of a program to prepare streams for increased runoff and simultaneously enhance or maintain natural values.

i. Impact 9

The ninth impact is the enhancement of warmwater fisheries.

Discussion: The establishment of permanent flow in heretofore intermittent streams (lower Cache, Oat, Bird, and Buckeye Creeks) could enhance the warmwater fishery of Site 5. Several problems may be encountered in creating perrenial flows in these streams. Turbidity may be a problem if the augmented flows stimulate accelerated bank cutting or slumping. This could impair the establishment of a sport fishery in a stream since many fish are sight feeders. TDS would have to be maintained below a level that would inhibit reproductive capacities of some fish (ie., under 1000 ppm.)

Remedial, Protective and Mitigative Measures: The enhancement of the present warmwater fishery would be beneficial. If problems such as turbidity and high TDS are encountered they will have to be overcome if some game fish such as bass or sunfish are present; however, catfish are more tolerant to high TDS and turbidity.

j. Impact 10

The tenth impact is increased crop depredation in Capay Valley.

Discussion: Enhancement of deer range on the slopes above Capay Valley by application of wastewater would increase the carrying capacity of that range. The Capay area is already a critical depredation area. Increased deer populations may lead to accelerated crop depredation in bordering valley agricultural lands. The carrying capacity is unknown and would require additional work.

Remedial, Protective and Mitigation Measures: Increase the number of special depredation deer hunts in the Capay Valley area.

Fence crop areas (requires special fencing techniques).

k. Impact 11

The eleventh impact is increased road kills of all wildlife.

Discussion: Application of sufficient wastewater to croplands in Capay Valley would encourage a change from orchards to field crops and pasture. The change in crop type might stimulate increased nightly migrations of deer herds to graze in croplands. An increase in road kills along Highway 16 would be expected, but the number of increased kills would depend on many variables.

Remedial, Protective and Mitigation Measures: Apply wastewater in Capay Valley at a rate moderate enough to maintain present crop types.

Develop local management program to effectively limit or channel nightly deer migration into the valley.

Clearly designate deer areas along highway.

Fence crop areas.

Limit application of wastewater to areas outside of Capay Valley.

l. Impact 12

The twelfth impact is a change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion: Wildlife and plant associations in areas of heavy wastewater application should experience a definite change in species association with increased moisture. Heavy misting or spraying in chaparral may encourage conifer growth. Misting during the summer in forest areas would promote the growth of more ferns, mosses, lichens and liverworts. Any change in the composition of native vegetation could result in a change in wildlife species. A change from grassland to marsh (rapid infiltration areas) would produce habitat more favorable to waterfowl and marsh inhabiting mammals (racoons, muskrat, etc.) Because of the field study needed it is impractical to determine how many animals would be affected by additional moisture until areas of probable rather than potential use are defined.

Remedial, Protective and Mitigation Measures: A change in ecosystems would produce a gross change or possibly a complete loss of the existing flora and fauna. While gaining a new species association

corresponding to the newly developed habitat, studies should be done that provide management tools for acquiring desirable species. The loss of the flora and fauna of one ecosystem cannot always, by management, be mitigated.

Protective and remedial measures would need to be taken if the original ecosystem was to be maintained in its original state. To lessen adverse changes to the ecosystem, less wastewater would have to be applied.

The creation of marsh lands, while an adverse impact for the agricultural associated wildlife on the pre-existing crop or pasture land, will provide habitat for the many species which are dependent on a marsh environment. As marsh lands statewide have been seriously reduced in acreage with the encroachment of man, production of permanent marsh habitat would be beneficial and a valuable ecosystem in view of its diminishing occurrence.

In large application areas, corridors of non-application should be maintained to permit the escape or relocation of wildlife species unable to adjust to higher levels of moisture. These "dry-out" zones would also allow circulation through application sites by migrating species. This is yet undetermined factor(increased moisture) that may adversely affect wildlife. Animal species that would be affected by an identifiable change in ecosystems can be ascertained from the species list (in the Appendix) by examining the habitat and food habits column of these tables. For example, additional moisture may displace the dry land deer mouse to the advantage of meadow mice which prefer moister areas.

m. Impact 13

The thirteenth impact is an increase in gamebird habitat.

Discussion: An increase in water available for farming may expand intensive agricultural practices into areas presently unused or only grazed. Row and field crops can supply habitat necessary to enhance populations of pheasant, dove and quail, provided that proper edge cover remains on the field edges. Hungry Hollow, Oat Valley and the lower reaches of the Dunnigan Hills are examples of areas capable of supporting increased gamebird populations if gamebird management programs are implemented along with intensive field cropping. Management and maintenance of edge cover along fences, canals, roads and planned plots or corridors would increase the habitat significantly.
This action would be a beneficial impact.

n. Impact 14

The fourteenth impact is an expansion of marshlands.

Discussion: Intensive application of wastewater to lands indicated as rapid infiltration areas in Volume II may stimulate marsh conditions. Even moderate application in poor drainage areas (Sacramento River basin, Yolo Bypass) would create wet habitats.

The creation of marshlands, while an adverse impact for the agricultural associated wildlife on the pre-existing cropland, will provide habitat for the many species which are dependent on a marsh environment. As marsh lands statewide have been seriously reduced in acreage with the encroachment of man, production of permanent marsh habitat would be beneficial and a valuable ecosystem.

This action is a beneficial impact.

o. Impact 15

The fifteenth impact is a change in streambank vegetation.

Discussion: Introduction of increased flows to Cache or Buckeye Creeks by application of wastewater either directly or indirectly to their channels may effectively alter present backside vegetation. Much of this vegetation growing on these streams is in the dry stream bed and not on the stream bank. This vegetation would be eliminated by permanent water flows. True riparian vegetation in these areas would be enhanced. These streams are presently intermittent and support riparian vegetation offering good cover for pheasant, quail, cottontail and jackrabbit. Increased flows may cause bank cutting and the removal of riparian habitat on upper Cache and Buckeye Creeks. On lower stream courses in the Sacramento Valley, riparian growth may be stimulated along the streambanks. While this would increase wildlife habitat, unchecked growth of riparian plants in the stream channel may impede floodstage stream flows and increase chances of over-bank flooding.

Remedial, Protective and Mitigation Measures: Maintain Cache and Buckeye Creek flows at a level below that conducive to bank erosion.

Develop a program to maintain open channels on all streams with high seasonal runoffs.

Confine permanent run off of wastewater to small portion of the streambed in Cache and Buckeye Creeks.

p. Impact 16

The sixteenth impact is increased mosquito and midge populations.

Discussion: Any increase in marshland, permanent pasture or ponded water would increase breeding habitat for mosquitos and midges.

The mosquito, besides being a nuisance insect, is also a carrier of human diseases. The midge, when present in large numbers, can be a nuisance and even obscure the vision of passing motorists by swarming in large clouds and collecting on windshields. Nuisance levels of insects may harass domestic and wildlife mammals. This will be a serious problem, large levels of these insects could be produced. Similar problem with mosquito production in rice fields.

Remedial, Protective and Mitigation Measures: Develop application and dispersal systems that utilize minimal standing surface waters.

Introduce insect larvae predator species to all surface water bodies.

Increase efforts of local mosquite control and abatement districts if management and biological controls are not effective.

q. Impact 17

The seventeenth impact is increased eutrophication of Sacramento River and connecting canals.

Discussion: Estimated recovery waters from wastewater disposal sites contain 6-20 mg/l total nitrogen in surface drainage and 3-20 mg/l total nitrogen in groundwater. Total phosphorous figures are 2-4 mg/l in surface and 1-2 mg/l in groundwater flows. Any addition of nitrogen and phosphorous to the Sacramento River is undesirable.

Expansion of irrigated pasture due to availability of wastewater may also accelerate eutrophication. Increased amounts of animal wastes near surface or groundwater flows that reach the Sacramento River and its associated canals would contribute additional nitrogen compounds to those waters and aggravate eutrophication. See discussion of Impact 5 for effects of eutrophication. Unsightly and odoriferous blooms of blue-green algae may result.

Remedial, Protective and Mitigation Measures: Control wastewater quality pre- and post-application to insure lowest possible total nitrogen and total phosphorous in waters discharged in Sacramento River.

Apply wastewater to areas with least amount of surface or subsurface drainage to Sacramento River.

Maintain stock free buffer strips between irrigated pasture and major surface drainage features.

r. Impact 18

The eighteenth impact is the loss of recreation opportunities and potential due to a reduction in water quality and in the quality and quantity of vegetation, fish and wildlife.

Discussion: Present and potential uses of recreational waterways, including the Sacramento River, Cache Creek, Colusa Basin Drainage Canal, Knights Landing Ridge Cut and the smaller drainage canals of sub-Area 5.6 could be diminished by a decrease in water quality that results in poor fishing and obnoxious sights and odors. The effect of recovery waters on recreational areas depends on the management schemes that are implemented, and the quality of recovered water. Algal blooms caused by excessive amounts of N&P introduced by wastewater could damage the fishing and recreation potential.
Reduction in water quality may result in reduction of fish species and numbers. Lowered dissolved oxygen, increased turbidity, and increased incidence of disease may result in diminishing fish populations.

Desirability of streams and streamside locations for picnicking, hiking, water skiing, boating and biking may be curtailed, especially along Cache Creek and the Sacramento River.

Remedial, Protective and Mitigation Measures: Monitor water courses that are receiving recovered wastewater to control and keep water quality within public health water contact specifications and requirements needed to maintain present fisheries and wildlife uses.

s. Impact 19

The nineteenth impact is the reduction in scenic value of roadside areas.

Discussion: Construction of permanent above-ground delivery and dispersal systems along well-traveled scenic routes will be a detriment to recreational values. Lands along Highway 16 in Capay Valley and along the riparian growth borders the Sacramento River are areas of special concern. Location of dispersal systems should be removed from contact by the general public for health as well as aesthetic reasons.

Remedial, Protective and Mitigation Measures: Delivery and dispersal systems for wastewater should be located away from roadways and popular recreation sites.

Planting of roadside trees and shrubs as visual screens would mitigate the undesirable aesthetic effects of delivery and dispersal systems clearly visible from roads.

t. Impact 20

The twentieth impact is the loss in educational value of Capay Valley.

Discussion: Capay Valley is frequently used as an outdoor classroom by local universities. Field trips to study the Valley's floral diversity, geologic structure and physical geography are common in the fall and spring months. Changes in land use, floral composition and extent of general ground cover would decrease the distinctive quality of Capay Valley as an outdoor laboratory. The close proximity of Capay Valley to major universities (S.F. Bay Area, Sacramento, and Davis) and its distinctive topography would make it specific for Site 5. Figures of its use are not available. Other areas are available for educational use but they do not have the quality and close proximity that Capay Valley offers.

Remedial, Protective and Mitigation Measures: Application of wastewater in Capay Valley should be maintained at a moderate level to avoid change in vegetative cover and composition.
Recovery water drainage into Cache Creek should be kept below the amount necessary to accelerate streambank erosion.
Capay Valley should be excluded as a waste disposal site considering its small size and its importance as an educational area, other parts of Site 5 are in much greater need of water (Dunnigan Hills and Hungry Hollow).

u. Impact 21

The twenty first impact is the generation of unpleasant odors.

Discussion: Extensive ponding of wastewater may lead to the production and dispersal of offensive odors. Odors may often be associated with septic conditions (from organic matter in reservoirs) and growth of blue-green algae.
This is expected to be a localized impact of significance to a small area.

Remedial, Protective and Mitigation Measures: Locate wastewater impoundments away from areas of human habitation and frequent use.

Aeration of ponded waters to prevent growth of anaerobic odor-producing bacteria

Prevent formation of stagnant pools of water.

Mask odors with chemical additives such as hypochlorite.

If pond has a short detention time, chlorinate waters to reduce anaerobic odor-producing bacteria.

v. Impact 22

The twenty second impact is the possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.

Discussion, Remedial, Protective and Mitigation Measures: See Site 4, Impact 15 materials.

w. Impact 23

The twenty third impact is the introduction of fish diseases and parasites into new areas by the application of treated wastewater.

Discussion, Remedial, Protective and Mitigation Measures: See Site 4, Impact 16 materials.

x. Impact 24

The twenty fourth impact would be the increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.

Discussion, Remedial, Protective and Mitigation Measures: See Site 4, Impact 17 materials.

y. Impact 25

The twenty fifth impact would be the increase in fish diseases because of higher water temperatures of recovered wastewater and increased bacterial growth.

Discussion: The temperature of the wastewater used for irrigation purposes in Site 5 could be greatly increased by exposing it to sunlight for long periods. Disposing of this recovery water into existing waterways (Cache Creek) could increase the bacterial production in the water. Rise in temperature depends on exposure to sun, needs further investigation. Proposed wastewater holding reservoir (s), if they are shallow "four-sided" type, could experience high water temperatures in the summer months. This could lead to high bacterial production in these waters, especially with a high organic load. If bacteria pathogenic to fish are present, they will also be increased in numbers.

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Remedial, Protective and Mitigation Measures: Control temperature of the recovered wastewater to a level that would not significantly increase the temperature of existing waterways.

z. Impact 26

The twenty sixth impact would be an increase in stress factors of fish and their relationship to the susceptibility of fish to disease and parasitism.

Discussion: There could be several conditions that promote fish diseases in Site 5 depending on the uses of wastewater. Oxygen sags because of algal blooms could be a problem in Cache Creek if reclaimed wastewater is used to augment the flow. Oxygen depletion could also result if "four-sided" reservoirs built to hold the wastewater are too shallow. Increased temperature (depends on temperature increase and other variables that may affect stress in fish), may promote fish diseases, by increasing stress factors in fish and lowering their general resistance, especially if the wastewater is first run over farmland exposed to the sun and then disposed of in a waterway. Both low dissolved oxygen and increased temperatures, are stress factors on fish, especially when they occur simultaneously.

Remedial, Protective and Mitigation Measures: Pre- or post-treatment of the wastewater to remove biostimulants to a level that would not degrade the quality of surface water.

Prevent discharging of wastewater into existing waterways, especially if the wastewater has had a long exposure to the sun and the mean water temperature is above that of surface waters.

aa. Summary of Sensitive Areas

Figure V-C-1 delineates the location of environmentally "sensitive" areas within Site 5. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas. The "sensitive" areas of Site 5 consist of (1) Cache Creek (Sub-Areas 5.4, 5.2, 5.1,) (2) the Colusa Basin Drainage Canal and Buckeye, South Fork Buckeye, Bird, Oat (including North and South Forks) Creeks in Sub-Areas 5.4 and

5.3, (3) the Sacramento River and its riparian vegetation in Sub-Areas 5.6 and 5.5, (4) Knights Landing Ridge Cut between Sub-Areas 5.4 and 5.5 and through 5.5, (5) the Yolo Bypass recreational area in Sub-Area 5.5, and (6) the scenic highway SR 16 through the Capay Valley (Sub-Area 5.1) and along the southern perimeter of Sub-Areas 5.1 and 5.2 to just west of Esparto.

The exact distribution and location of Rare and Endangered Species on Project Area is not known.

SECTION D

D. WASTEWATER LAND APPLICATION SITE 18: NORTHERN MARIN-SOUTHERN SONOMA COUNTIES COAST

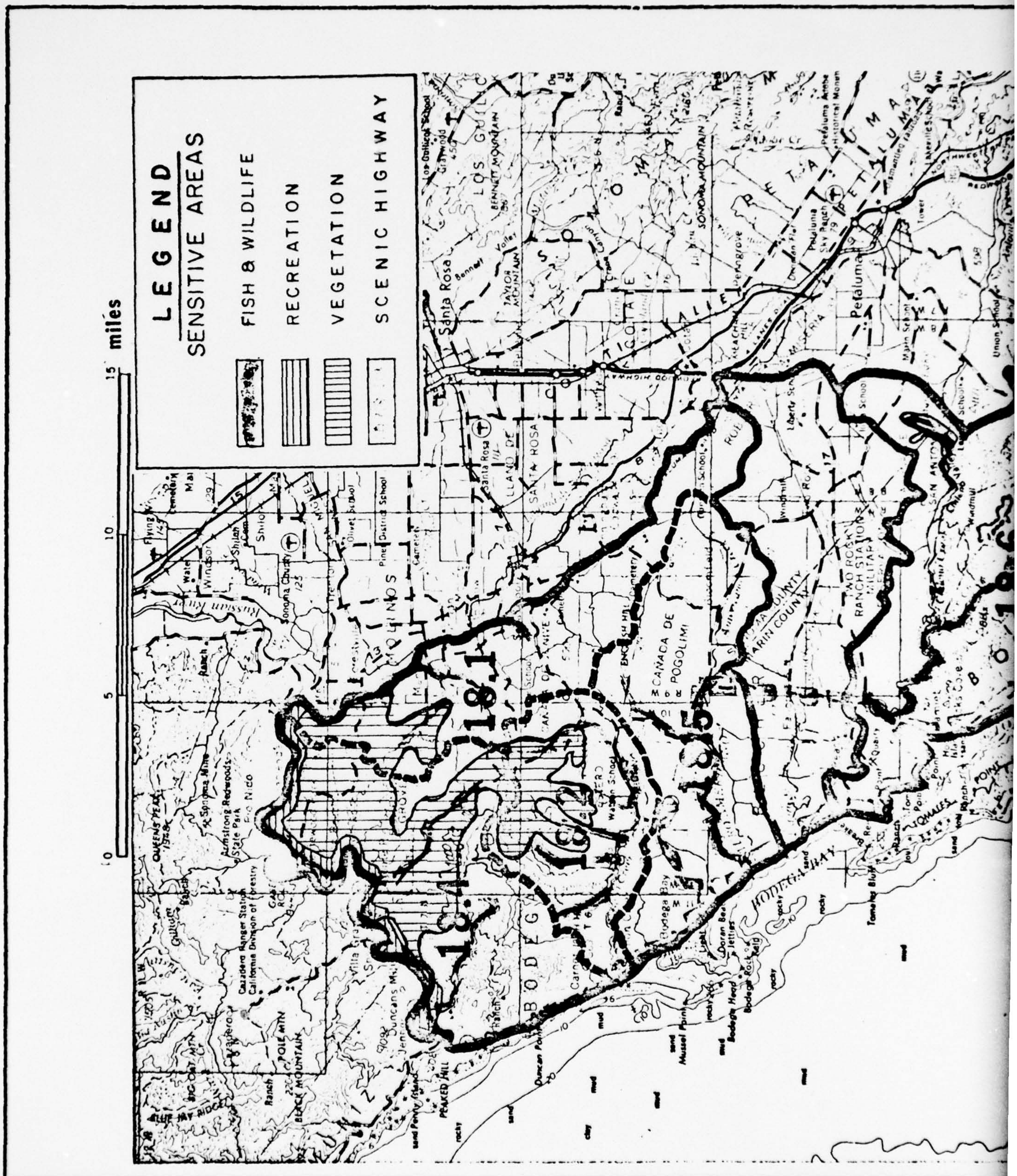
1 - Project Development

a. Present Land Uses

Site 18 includes southwestern Sonoma County south of the Russian River and generally west of the Santa Rosa-Cotati-Petaluma Valley and northwestern Marin County generally east of Bodega and Tomales Bay and north of Lagunitas and San Geronimo Creeks. Santa Rosa is located about 9 miles east of the site's eastern limits; Sebastopol, Cotati, Petaluma, and Novato are located 1, 2, 4, and 3 miles, respectively, east of the site's closest eastern limits. San Rafael is located about 6 miles south-east of the site's southeastern corner in Marin County. The lower reach of the Russian River, from Bridge Haven near its mouth to Green Valley Creek near Del Rio, provides the Site's northern perimeter. The western perimeter is provided by (1) State Route 1, the coast highway, from Bridge Haven south to the south end of Bodega Harbor, except for two small "detours" east around the town of Bodega Bay, (2) the eastern boundary of Doran Park, (3) Bodega Bay shoreline south to San Point and subsequently the east shoreline of Tomales Bay to the mouth of Lagunitas Creek, and (4) Lagunitas Creek to its confluence with San Geronimo Creek. The southern perimeter is provided by San Geronimo Creek east to its watershed limits. The eastern perimeter is provided by (1) the drainage divide between San Francisco Bay-San Pablo Bay and Tomales-Bodega Bays north to Stony Point Road just southwest of Cotati, (2) subsequently Stony Point, Roblar, Petersen, Blank, Canfield, Pleasant Hill, Elphick, and Water Trough Roads, the last to Atascadero Creek, and (2) Atascadero Creek north to its confluence with Green Valley Creek, then Green Valley Creek to its confluence with the Russian River. Use Figures V-D-1, V-D-2, and V-A-7 for location reference.

Site 18 occupies about 196,200 acres. For study purposes, it has been divided into six sub-areas as shown in Figures V-D-1 and V-D-2. These sub-areas and their areas are as follows:

Sub-Area No.	Sub-Area Designation	Area in Acres
18.1	Sebastopol	23,400
18.2	Salmon Creek	20,000
18.3	Lagunitas Creek	35,400
18.4	Russian River	25,700
18.5	Estero Americano	29,100
18.6	Tomales Bay-Walker Creek	62,600



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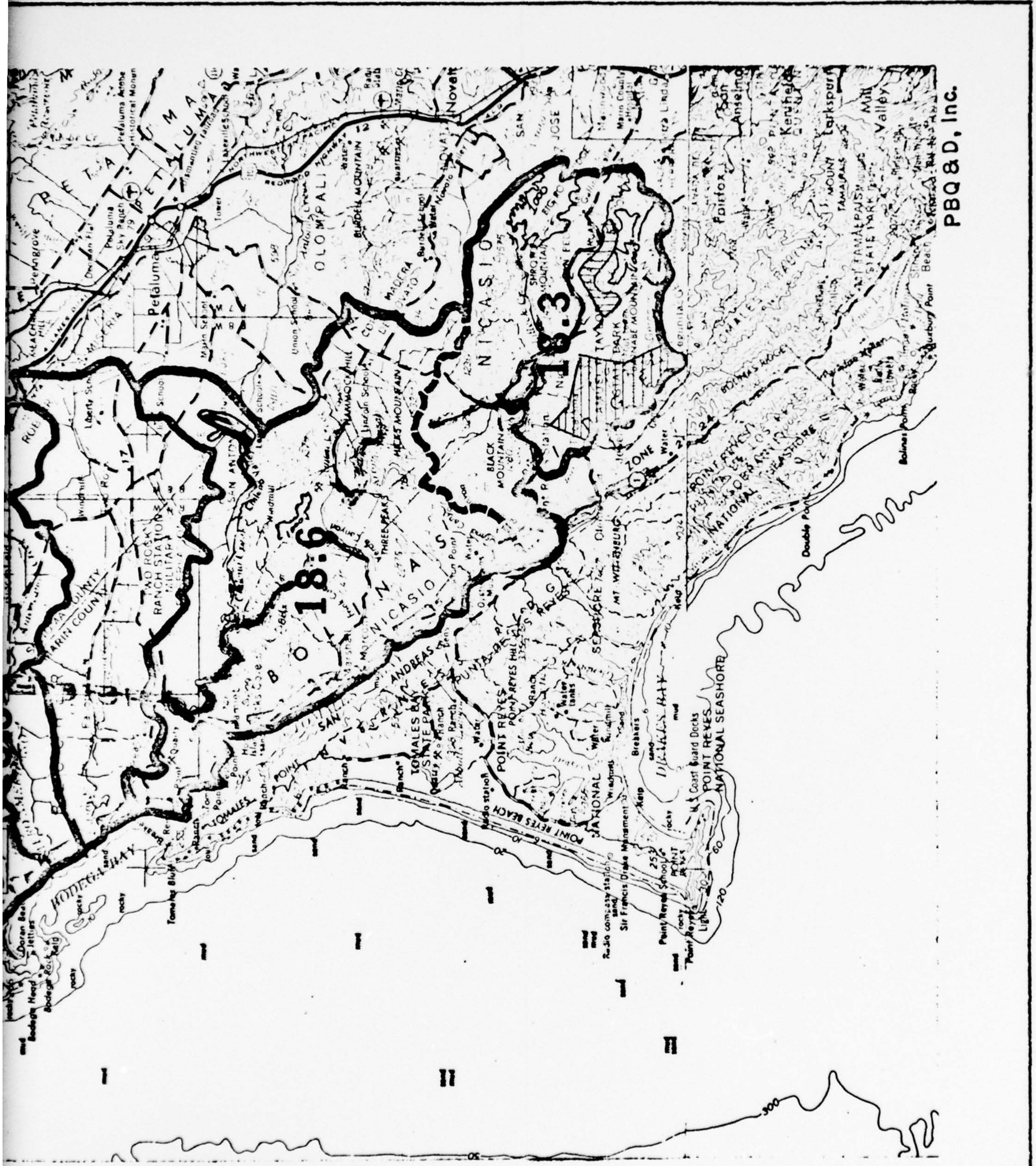

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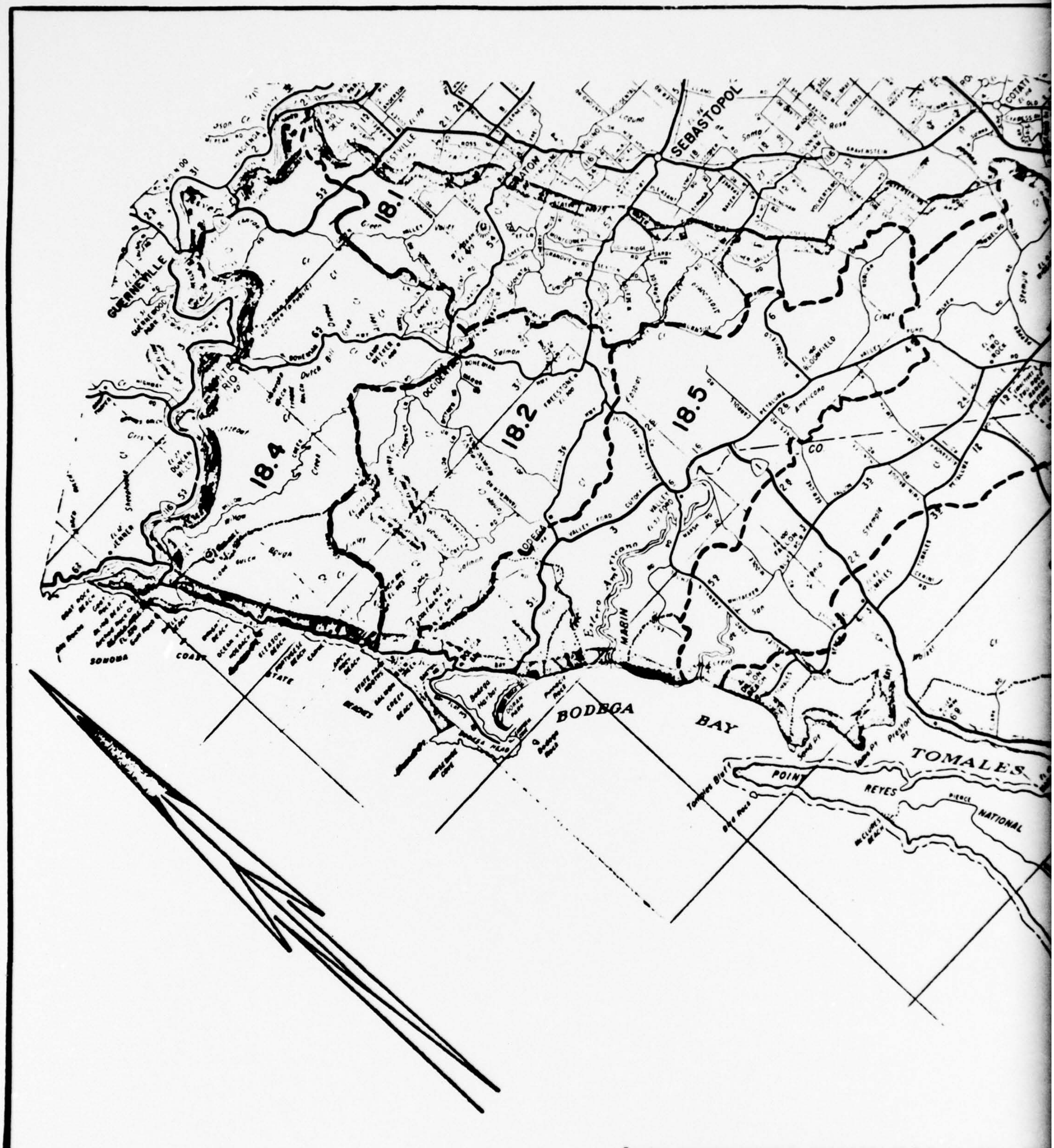

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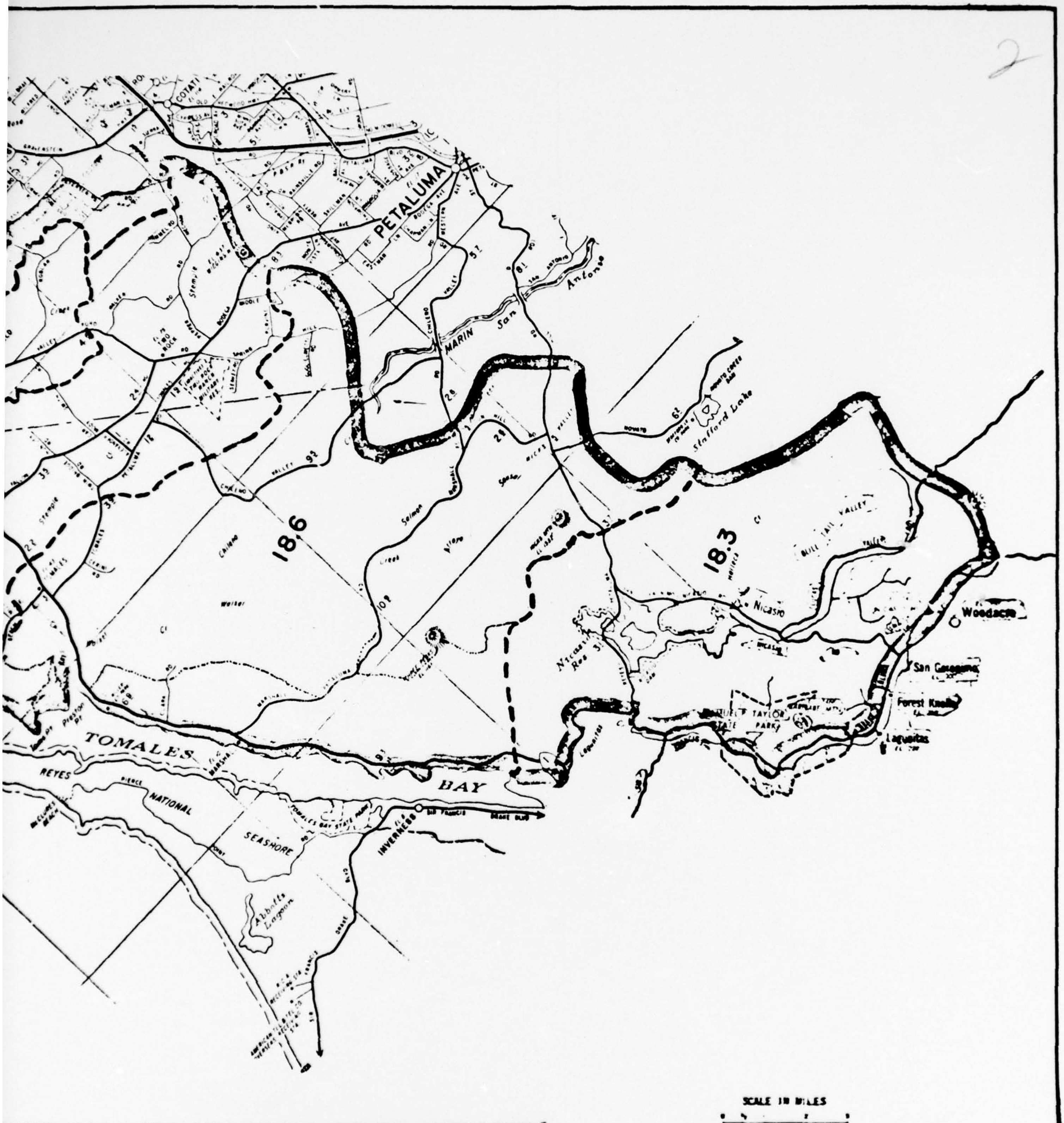

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Site 18 excludes the Estero San Antonio-Stemple Creek watershed because of poor soil conditions. This exclusion effectively divides Site 18 into a northern and southern section.

The various habitats in the extensive Site 18 area range from sand dunes to salt marshes and from redwood forests to salmon streams. The coastal and forested areas provide convenient recreation areas to the Bay Area communities. The Russian River area has for many years been a widely used recreation area. Agriculture is a major land use activity throughout Site 18. There are a considerable number of orchards and small farms in the northern part of Site 18. The rest of the Site is comparatively dry and used mostly for grazing. The most significant of the orchard crops is apples. The southern sections of the Site Area have been the subject of a great deal of controversy in master planning for the future with emphasis on open space. The California Protected Waterways Plan designates the Russian River as a Class I premium scenic, fishery, wildlife, and recreation waterway. It also classifies Tomales Bay as a Class II scenic, fishery, wildlife and recreation waterway. The Site has a moderately extensive system of roads and it is dotted, here and there, with a number of small towns.

As to possible future development, some consideration has been given to the construction of a dam and reservoir on Walker Creek to develop a better water supply for northern Marin County and the Marin Municipal Water District which services much of this section of the country.

b. Development Objectives

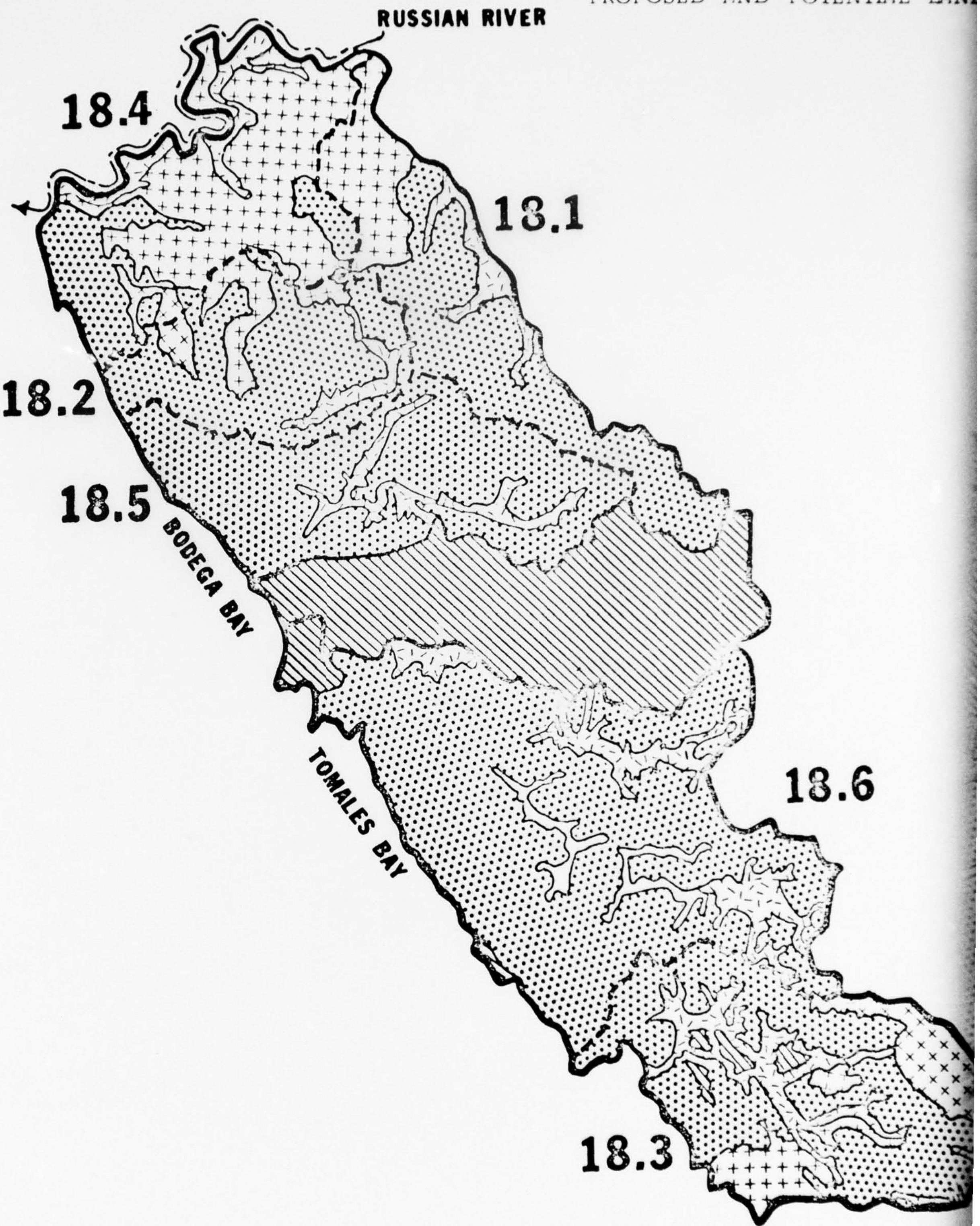
Site 18 is the second largest of the selected land application study sites. It is representative of various coastal and coast range sites. The principal application proposed is pasture land irrigation. It also offers a potential for development using redwood or Monterey pine forests. Related to this forestry potential are various uses for recreation or open space for which the area is generally designated in the appropriate county plans. Development objectives also include the possibility for stream flow augmentation by the application of more water than normally occurs from rainfall and by restoring some of the forest cover. Drainage of the wastewater application to the southern part of the area would be into the basin tributary to the water supply reservoir near Nicasio. This raises the issues and technical problems concerning the application of wastewater into a drainage basin from which water supply is extracted. The applied treated wastewaters for this area would be transported from the developed areas of southern and central Marin County and central Sonoma County.

Proposed land uses and types of land application based on soil capabilities are shown in Figure V-D-3. This figure also shows areas excluded because of generally prevailing poor soil conditions. Areas with slopes over 30 percent predominating are delineated in Figure V-D-4. This figure indicates that significant portions of some areas of Site 18 exhibit these excessive slopes. These areas are strong candidates for exclusion because of erosion embankment and possible landslide conditions. These areas were delineated as a result of on-site inspections and subsequent topographic map analysis. Recommended unit application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10.

The possible sources include urbanized and suburbanized Marin County to the south and southeast; Santa Rosa , Sebastopol, Cotati, and Petaluma from the Santa Rosa-Cotati-Petaluma Valley; Sonoma and other communities from the Valley of the Moon and Sonoma Valley; several small communities inside Site 18 and adjacent to it, such as Inverness, Del Rio; Windsor and the Windsor area to the northeast; Napa and other communities from the lower Napa Valley; Vallejo and the western and northwestern urbanized and industrialized areas of Contra Costa County; and from the Bolinas Bay area to the southwest. These treated wastewaters can be brought into the Area along any number of major or minor roadways. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible sources of wastewater indicated above.

The distribution and recovery systems will follow the management and development outlines presented in Section A-7a, b, and c. The estimated quality of recovered wastewaters is that presented in Table V-A-7. Since the general conveyance of wastewaters to Site 18 is uphill, it is expected that the distribution systems will be designed much like any water supply distribution system complete with pressure zones to minimize pumping costs. The lowest elevations encountered along the eastern perimeter are practically all along the major roadways. From north to south, these are (1) about 70 feet at River Road along the Russian River, (2) 330 feet at the high point along SR 116 between Sub-Sites 18.1 and 18.4, (3) 780 feet, Gratton Road, between 18.1 and 18.4 (also north-central access to 18.2), (4) 486 feet, Bodega Highway, between 18.1 and 18.2, (5) 375 feet, Bloomfield Road, between 18.1 and 18.5 (Estero Americano drainage), (6) about 330 feet, Roblar Road, between 18.1 and the Americano

PROPOSED AND POTENTIAL LAN



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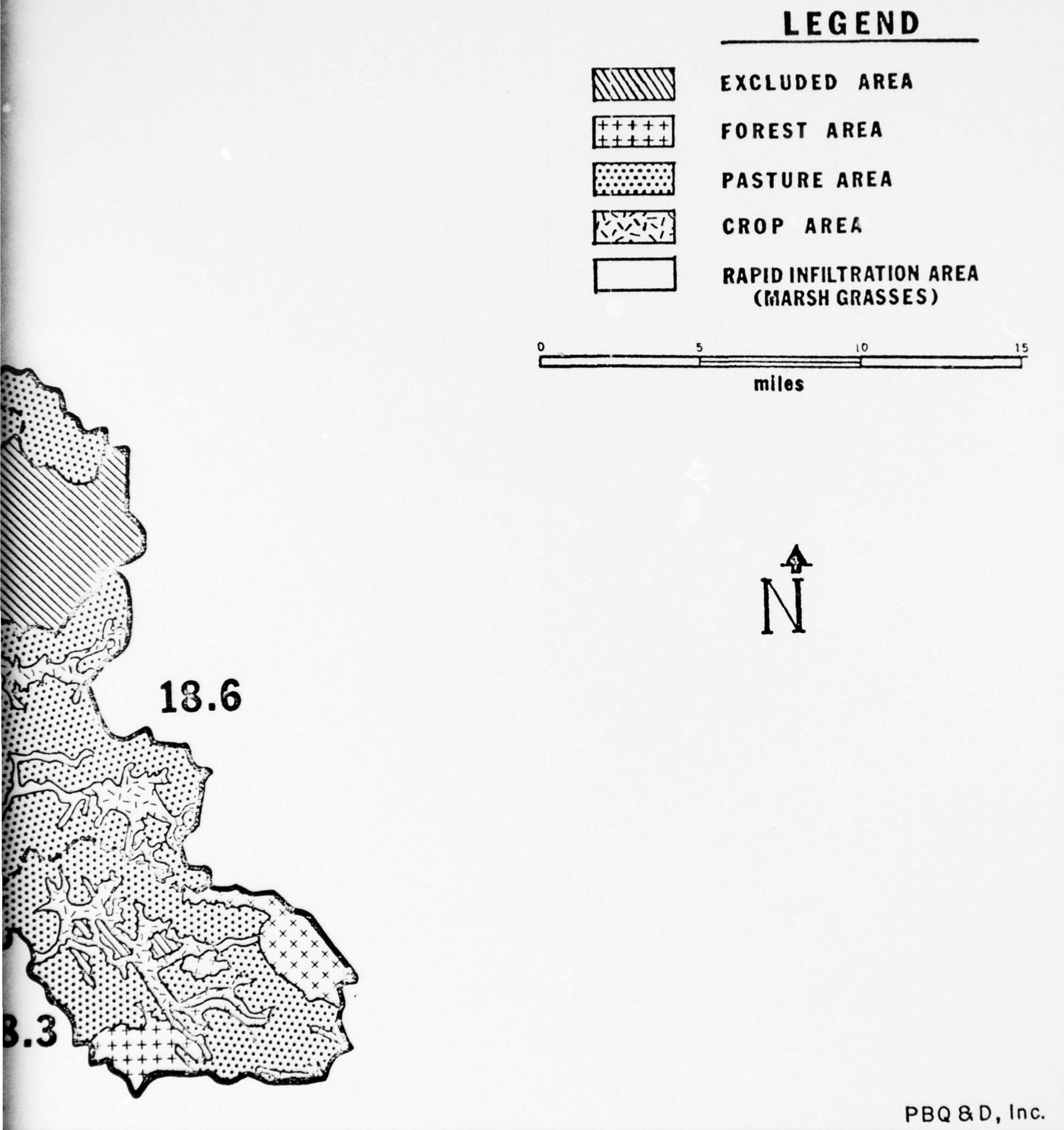
ROPOSED AND POTENTIAL LAND USES FOR WASTEWATER LAND APPLICATIONS



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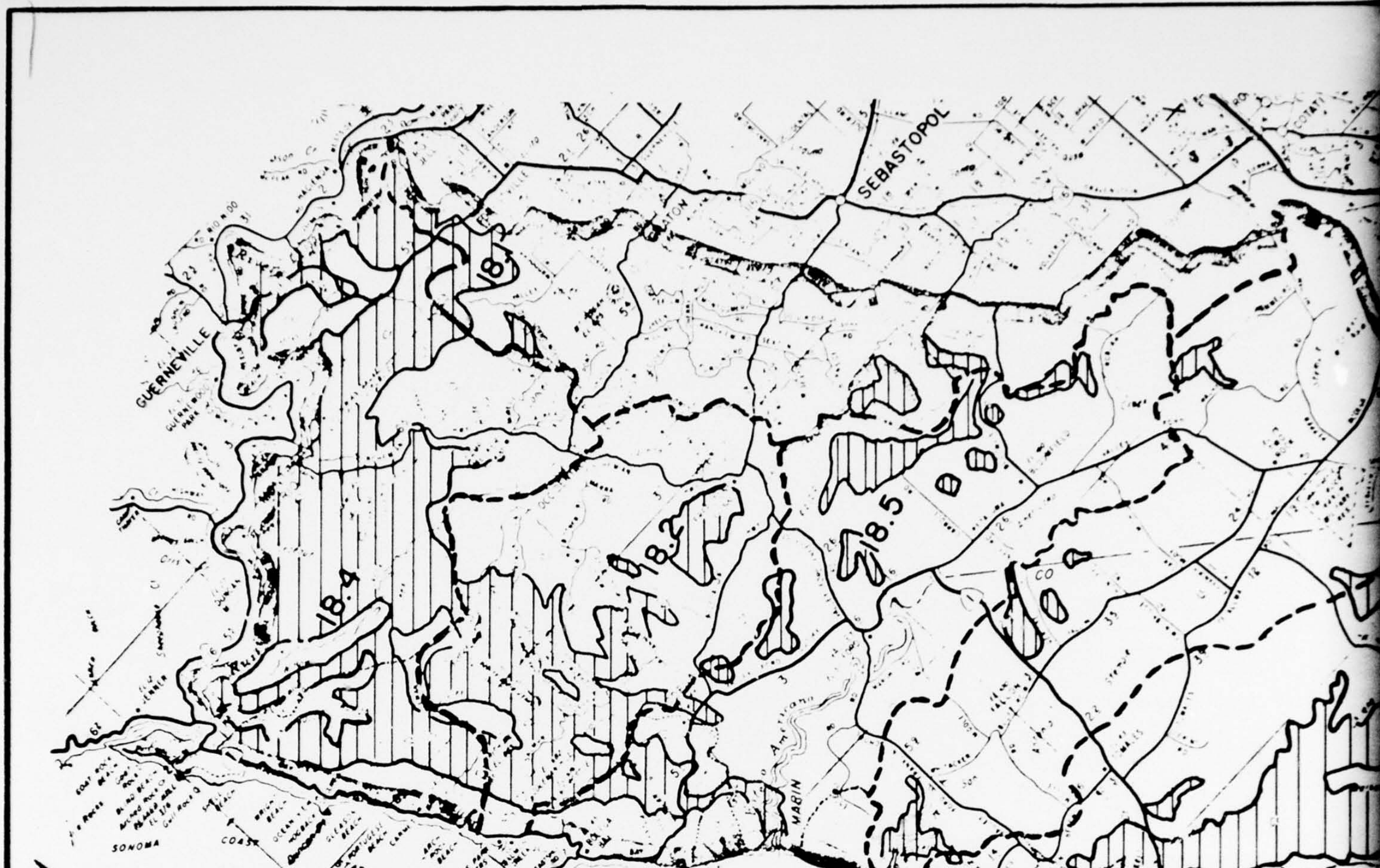

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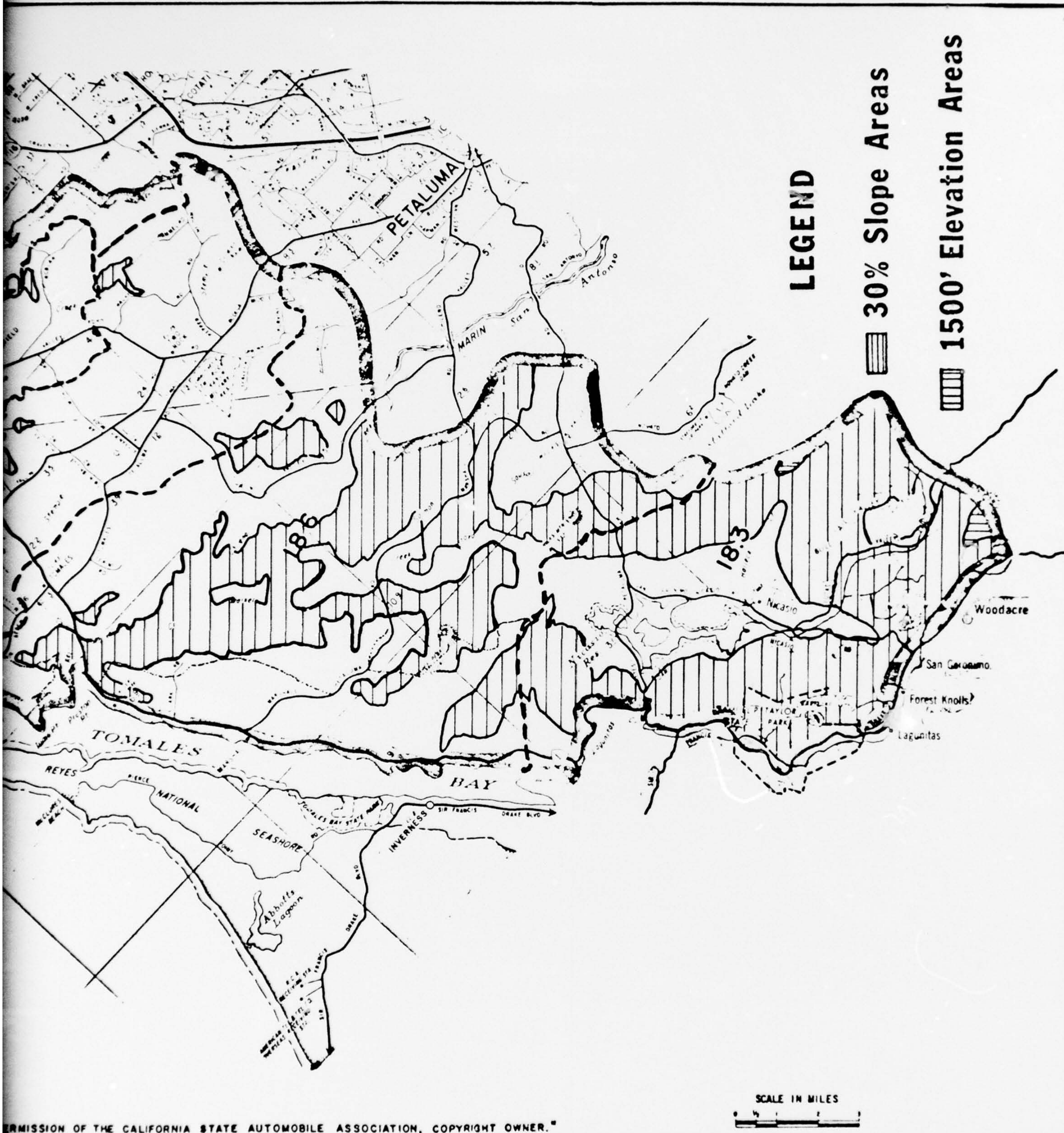
LEGEND
30% Slope Areas
1500' Elevation Areas
PETALUMA
MARIN
Nicasio
Woodacre
San Geronimo
Forest Knolls
Lagunitas
TOMALES
BAY
REYES
NATIONAL
SEASHORE
INVERNESS
Abbotts Lagoon
SCALE IN MILES
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Creek drainage (18.5), (7) 160 feet, Pepper Road and 290 feet Bodega Ave. at their eastern accesses to the Estero San Antonio drainage, subsequently 170 feet at Ford Valley Road's entrance into the Estero Americano (Sub-Area 18.5) and 178 feet at Tomales-Petaluma Road's entrance into the lower Walker Creek drainage (Sub-Area 18.6), (8) 260 feet, Chileno Valley Road, at entrance to Sub-Area 18.6 from the east, (9) 732 feet, Marshall-Petaluma Road, at entrance to Salmon Creek drainage (a tributary of the Walker Creed basin, Sub-Area 18.6) from the east, (10) 645 feet, Point Reyes-Petaluma Road, at entrance to Hicks Valley (Arroyo Sausal of the Walker Creek basin) from the east, (11) about 520 feet, Novato Road, at southeast entrance to Hicks Valley, (12) about 650 feet, Lucas Valley Road (Arroyo Nicasio, Walker Creek basin) at entrance into Sub-Area 18.6 from the east, and, (13) 486 feet, Sir Francis Drake Blvd., at the entrance to San Geronimo Creek (Sub-Area 18.3) from the southeast. A review of these listed high access elevations indicate that most of the coastal and interior valley flatlands of Site 18 could be served by gravity lines once wastewater had been conveyed into the Site at the various low entry or access points.

The location of conveyance and pumping facilities in the more mountainous portions of the Site Area will require substantial analysis of flow and pumping requirements in relation to physical relief. In the areas with much less pronounced relief, conveyance and pumping facilities could generally be located in alignments unrestricted by topography. It is expected that major distribution will be along the major roadways with laterals branching off at selected elevations at the higher entrance points to some valley areas and following these elevations around the valley perimeter for purposes of gravity distribution. The prime candidate area for land application include the Estero Americano drainage (Sub-Area 18.5), the upper portion of the Salmon Creek basin (Sub-Area 18.2), the southern portion of Sub-Area 18.1, the northern section of the Walker Creek drainage and major portions of the east Tomales Bay minor drainage basins in Sub-Area 18.6, and central or Nicasio Reservoir area of the east Lagunitas Creek drainages (Sub-Area 18.3). Since most of this is proposed for pasture land irrigation, no sub-surface recovery systems are proposed. Such recovery as deemed necessary or advisable can be accomplished by constructing small catchments or impoundment areas on the many small tributary channels which drain the areas and pumping the recovered wastewaters away.

2 - Environmental Setting Without the Project: Geophysical and Geochemical

Site 18 lies wholly within the Coast Range geomorphic province, its two generalized physiographic regions being highlands comprising rolling hills (between 300 and 1000 feet) and fairly rugged small and low open mountains which rise to elevations over 1100 feet along most ridge lines, and intermountain valleys which are generally youthful and V-shaped. The area is 20 to 50 percent gently sloping with over 75 percent of the gentle slopes being in the lowlands, a characteristic of most of the Coast Range from Santa Barbara County to the lower Russian River drainage basin. Elevations in the Site extend from sealevel (along Bodega and Tomales Bays) to 1887 feet in the Big Rock Ridge (southwest of Novato, in the headwaters area of Halleck Creek, Nicasio Creek tributary in Sub-Area 18.3).

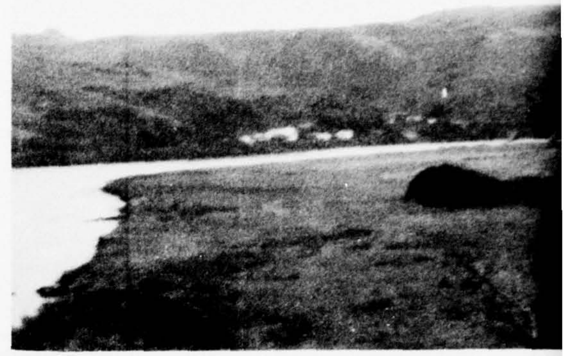
Sub-Area 18.3 is an area of low mountains and steep hills which are dissected by irregular long and narrow gorge drainageways. The relief of the Sub-Area 18.6 ranges from rugged hills, narrow ridges, to smooth rolling grassy low hills and mounds. The hills and mountains of these two sub-areas are part of the Bolinas Ridge-Mt. Tamalpais mountain group which dominates the Marin peninsula. Sub-Areas 18.2 and 18.6 in Sonoma County are areas of rolling hills and fairly rugged small mountains which are part of the Coast Range extending northward up the California coast. The highest elevations in this northern sector are just under 1300 feet along the divide between Sub-Areas 18.2 and 18.4. Between the two low mountainous sectors are the moderately wide, flat valleys and low rolling hills of the Estero Americano (18.5) and the Estero San Antonio (excluded). Rolling hills ranging between 300 and 400 feet separate them. The valley of the Estero San Antonio is almost a westerly extension of the Petaluma Valley, the latter along with the Sonoma and Napa Valleys being major northerly extensions of the great San Francisco Bay depression. Sub-Area 18.1 is an area of steep and rolling hills and the flat western terraces and floodplains of Green Valley and Atascadero Creeks, except for a small southern segment which includes some rolling hills on the western side of the Cotati Valley. Figures V-D-5a, 5b, 5c, and 5d show some typical views of the Site.

a. Geology and Hydrology

Summary of Geology: The predominant sub-surface strata in Site 18 is made up of Franciscan Assemblage sedimentary rocks of late Mesozoic age (latest Jurassic to Cretaceous approximately 140 to 60 million years old). They are composed of graywacke, shale, conglomerates, and chert together

Site 18

1. NE Up Russian River; Slopes of N Bank Coastal Range Mountains on Horizon; S Bank Flood Plain in Center Ground from Highway #116 NE near Intersection of Highway #1



2. Same Location S Down Russian River t
Haven with Highway #1 in Foregro

4. NE View Up Russian River
Same Location

5. N Acros
an Uppe
Flood P
Valley
Guerne

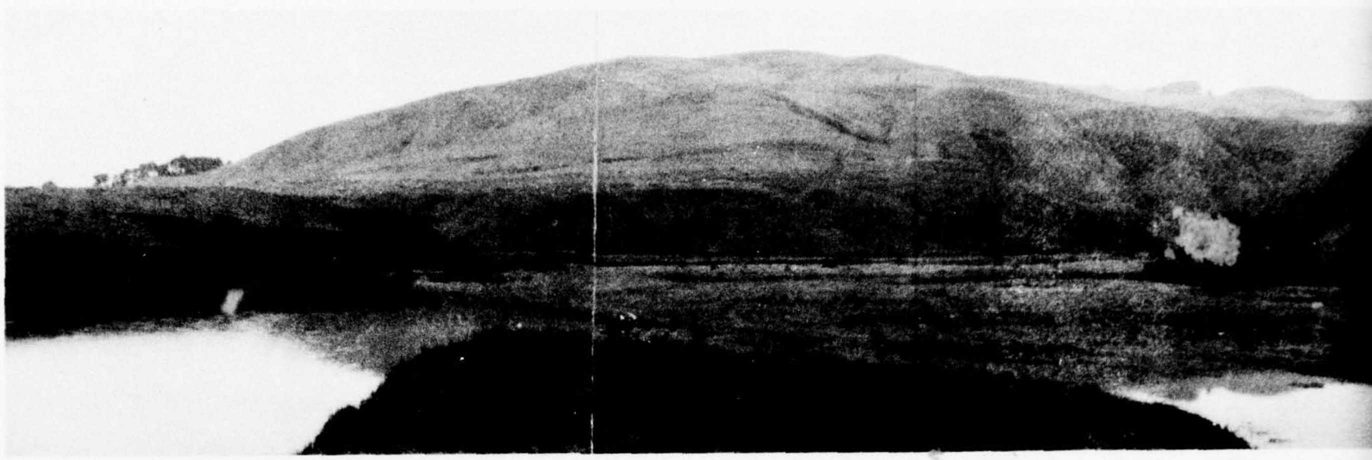
6. NE Across Upper Portion of Salmon Creek Flood Plain Above Freestone from Bohemian Highway NW of Freestone

Site 18

cation S Down Russian River toward Bridge
en with Highway #1 in Foreground

3. SE Down Russian River from Highway #116
Opposite Vacation Beach

5. N Across a Portion of an Upper Green Valley Flood Plain from Green Valley Road SE of Guerneville Highway



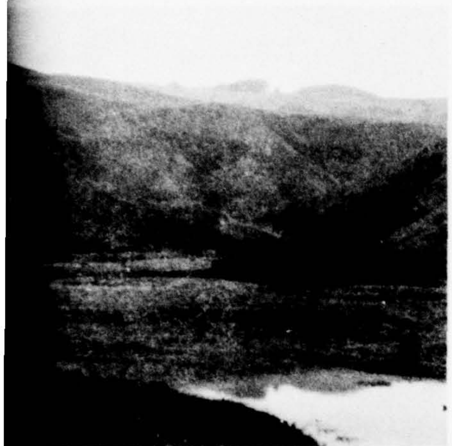
7. NE Up Salmon Creek, Slopes of Irish Hill on Horizon Taken from Highway #1 Bridge Over Salmon Creek

9. SW Over W Slopes of Bolinas Ridge Tomales Bay in Center-Ground from Marshall-Petaluma Road

10. SW Across Upper N Leg of Salmon Cre
Flood Plain from Chileno Valley F

12. SE Toward Point Reyes Station Across Mud-Flats of Lagunitas Creek Delta Channel

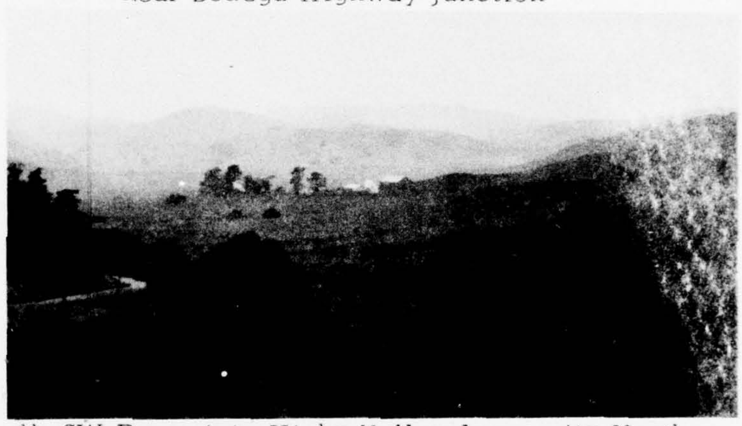
Site 18



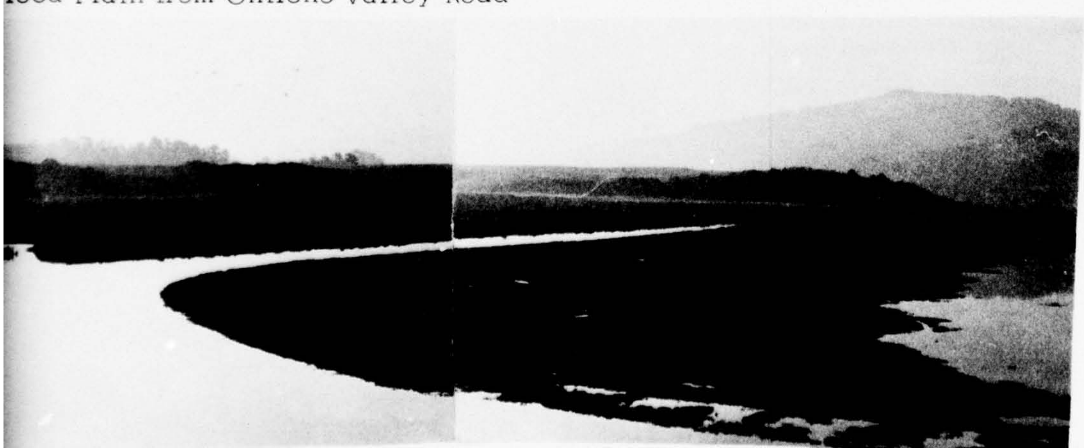
from Highway #1

8. E Up South Side of East Leg of Ebabias Creek Flood Plain with Farm Pond in Foreground and the Slopes of the Canada De Pogolimi on Horizon at Valley Ford-Freestone Rd near Bodega Highway Junction

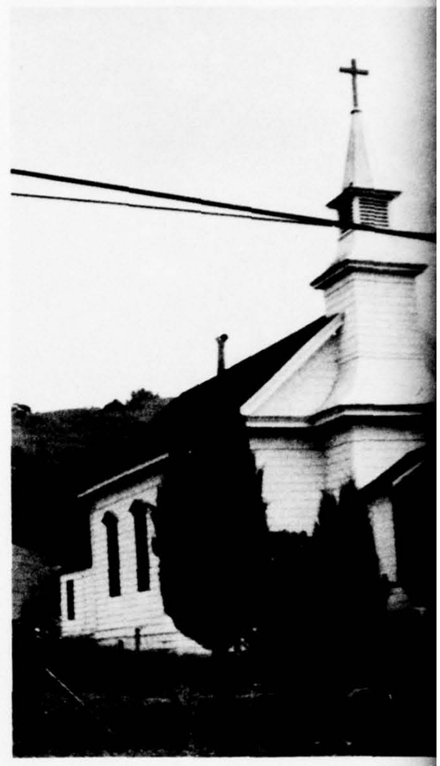
cross Upper N Leg of Salmon Creek Drainage lood Plain from Chileno Valley Road



11. SW Down into Hicks Valley Across its Northern Perimeter Slopes from Point Reyes-Petaluma Rd

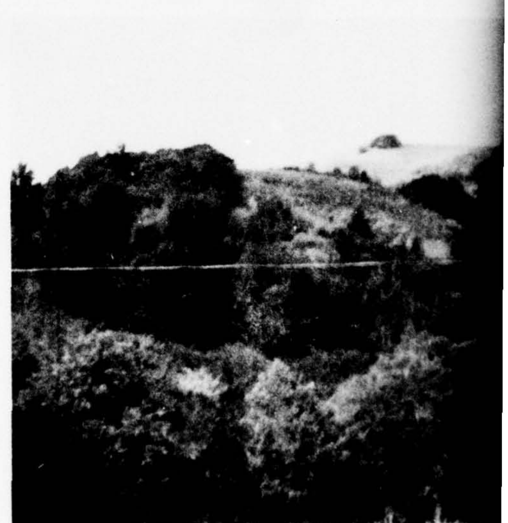


13. W toward Black Mountains from Nicasio Road near Junction of Point Reyes-Petaluma Rd



14. Church of Our Lady of Lor
in Nicasio from Nicasio

16. N View of Rolling Hills in San Geronimo Creek Drainage from Nicasio Road Up from Sir Francis Drake Highway



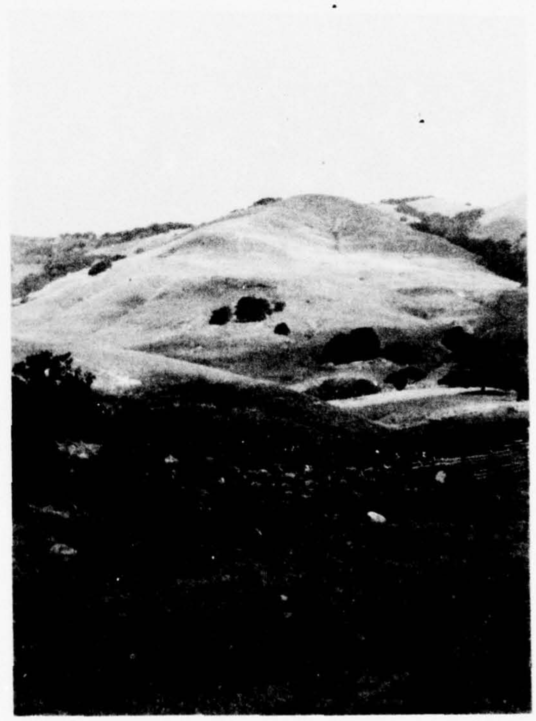
17. NE View Up Lucas Valley from Luc

Site 18

14. Church of Our Lady of Loretto
in Nicasio from Nicasio Rd

15. SW into San Geronimo National Golf Course from
San Geronimo-Nicasio Rd just N of Sir Francis
Drake Highway

iew Up Lucas Valley from Lucas Valley Road



18. NW View of Lucas Valley on
Big Rock Ranch at
Lucas valley Road

19. South Down the Coast from Goat Rock
of Sonoma State Beach

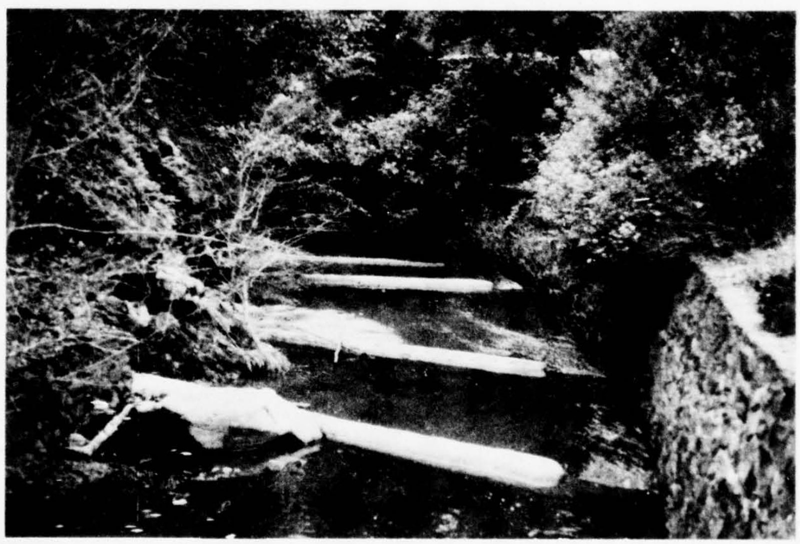
20. W

21. E Down Slope from Lagunitas Creek on Platform
Bridge Road near Intersection of
Sir Francis Drake Blvd close to
Tocaloma, Showing Dairy Feed Lot and Stream
Pollution Problem

Site 18

20. W Down the Estero Americano from Valley Ford
Franklin School Road Bridge

n



22. S Down Dutch Bill Creek on Bohemian Highway
about 2 miles N of Camp Meeker
Showing Flood Control Channelization

with minor lenses of limestone, glaucophane schists and related metamorphoric rocks. This strata underlies most of Sub-Area 18.2, 18.3, 18.4, and 18.6 and is found in strips along the channel areas of the Estero Americano and the Estero San Antonio. It is considered the "basement" formation of the area. Upper Pliocene (about 1 to 6 million years old) marine sedimentary strata underlie most of the Estero Americano basin (18.5), the Estero San Antonio basin (excluded), and Sub-Area 18.1. This strata is composed of fossiliferrous marine sandstone, siltstone, silty clay and is interbedded with gravels and basal tuff beds. Stream and valley alluvium deposits are found frequently along most surface water channels. Mesozoic ultrabasic intrusive rock strata (130 to 155 million years old) are scattered in small zones underlying the higher elevations of Sub-Areas 18.2, 18.4 and 18.6. These rock strata, which is part of the "basement" formation, is composed of serpentine, peridotite, dunite, and pyroxenite together with minor amounts of silica-carbonate rocks derived from the alteration of serpentine. Upper Cretaceous (60 to 110 years old) marine sedimentary rock strata underlie most of Big Rock Ridge. This strata is composed of sandstone, conglomerates, and shale. The San Andreas Fault zone runs along Tomales Bay. This and other fault lines are shown in Figure V-A-5. (Refs. 2,9.)

Summary of Hydrologic Systems and Water Quality Conditions: Site 18 is primarily an area of direct Pacific coastal drainage basins. The major exceptions are those tributary to the lower east-west leg of the Russian River and those tributary to Tomales Bay.

Sub-Area 18.4 is composed of two distinct basin groupings, those tributary to the south bank of the Russian River, and those directly tributary to the Pacific Ocean between Gulf Rock and Mussel Point, i.e., the Sonoma Coast State Beaches minor coastal drainges. The larges of the Russian River south bank drainges are those of Willow Creek, Freezeout Creek, Dutch Hill Creek, Smith Creek, and Mays-Pocket Canyons. The largest of the minor Sonoma Coast State Beaches coastal drainages are those of Furlong Gulch and Scotty Creek. Sub-Area 18.2 is made up entirely of the Salmon Creek watershed; it is the major drainage of the Sonoma Coast State Beaches coastal area.

Sub-Area 18.5 is composed predominantly of the Estero Americano-Americano Creek watershed which drains into Bodega Bay. Three other minor areas of 18.5 also drains into Bodega Bay; (1) the east Bodega Harbor-Chenny Gulch drainages through Bodega Harbor, (2) the minor northern Bodega Bay-Short Tail Gulch drainages north of Estero Americano, and (3) the minor central Bodega Bay coastal drainges south of Estero Americano. The Estero San Antonio-Stemple Creek watershed drains into the central part of Bodega Bay.

Sub-Area 18.6 consists predominantly of the Walker Creek watershed which drains into the upper and northern end of Tomales Bay just south of Preston Point. Tomales Bay drains into the southern end of Bodega Bay. Tomales Bay is a true estuary. The next largest drainage unit of Sub-Area 18.6 are the east shore Tomales Bay minor drainages. The residual area of Sub-Area 18.6 are the contiguous Sands Point-to-Preston Point northeast Tomales Bay minor drainages (which empty into the north end of Tomales Bay) and the minor south Bodega Bay-Dillon Beach area costal drainges (which empty directly into Bodega Bay). The major tributaries to Walker Creek (from north to south) are Keys, Chileno, and Salmon Creeks, and Arroyo Sausal.

Sub-Area 18.3 is composed entirely of areas within the Lagunitas Creek watershed which empties into the south end of Tomales Bay. Sub-Area 18.3, however, includes only those drainages which are tributary to the watershed which are located east of Lagunitas Creek from its mouth up to its confluence with San Geronimo Creek, and north of San Geronimo Creek for the latter's entire length. The largest tributary drainage is that of Nicasio Creek, which occupies all of 18.3 except its northwest corner and a band along its southwestern and southern perimeter.

Sub-Area 18.1 is composed predominantly of areas which drain into the Russian River through Green Valley Creek at Del Rio. This partial Green Valley Creek watershed includes all areas which drain into Green Valley Creek from the west between the creek's mouth and its confluence with Atascadero Creek, all of upper Green Valley Creek basin (above Atascadero Creek), all areas which drain into Atascadero from the west from its mouth south to Trough Road, and subsequently the entire upper Atascadero Creek drainage west of Trough and Pleasant Hill Roads. The southern small portion of 18.1 comprises the upper Blucher-Gossage-Washoe Creeks drainages (above Canfield, Blank, Petersen, Roblar, and Stony Roads). These small channels drain into the Russian River just above Del Rio through Leguna de Santa Rosa and subsequently Mark West Creek which flows through the large Cotati-Santa Rosa Valley.

No large groundwater basins underlie any areas within Site 18. The closest large groundwater basin lies just west of Sub-Area 18.1 under the Cotati-Santa Rosa Valley.

Estimated water quality conditions for the surface and ground waters in and around Site 18 are presented in Table V-D-1. The surface waters range from soft to hard; so do the groundwaters. The predominant ions in the surface waters are calcium, magnesium, and bicarbonate. In general, current water quality is reasonably good.

Table V-D-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 18

Water Quality Characteristics	Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Total Dissolved Solids:			no numerical standards
Generalized Area Estimates	110-340 mg/l	127-560 mg/l	170 mg/l med. (Russ. R.) 200 mg/l max. (Russ. R.)
Electro-Conductance: (in micromhos)			
Russian River:			285 median
Range	248-840 2/		320 maximum
Daily Averages	270-810 2/		
General Av.	about 300 2/		
Total Hardness:			nns
Gen. Area Est.	40-232 mg/l	35-294	
Russian River	52-150 2/		
Total Non-CO_3 Hardness:			nns
Gen. Area Est.	0-61 mg/l		
Russian River	2-11 2/		
pH: Russian River	7.3-8.3 2/		6.5-8.5 (Russ. R.)
Temperature:			nns
Gen. Area Est.	60-64°F median		
Russian River	55-77°F 2/		
Dissolved Oxygen:			5.0 mg/l min. (tidal waters south of mouth of Tomalaes Bay)
Russian River	8.1-10.6 mg/l 2/		10 mg/l med. (Russ. R.) 7.0 mg/l min. (Russ. R.)
Turbidity: Russian R.	5-280 JTU 2/		
Sediments:			
Gen. Area Est.	280-1950 mg/l		nns
Ca: Russian River	12-29 mg/l 2/		nns
Mg: Russian River	5.3-18 mg/l 2/		nns
Na: Russian River	5-12 mg/l 2/		nns
Na: Gen. Area Est.	11-23%	19-83%	nns
K: Russian River	---		nns
CO_3: Russian River	0 mg/l 2/		nns
HCO_3: Russian River	65-173 mg/l 2/		nns
SO_4: Russian River	--- 2/		nns
SO_4: Gen. Area Est.	---	3-60 mg/l	

Table V-D-1 (continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 18

Water Quality Characteristics		Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Cl:	Russian River	4-11 mg/l 2/		nns
	Gen. Area Est.		5-124 mg/l	
NO_3:	Russian River	--- 2/		2.0 mg/l med. (Russ. R.)
B:	Russian River	--- 2/		nns
	Gen. Area Est.	0-3.0 mg/l	0-2.0 mg/l	
Coliform Organisms: (in most probable no.) Russian River				50/100 ml (for disinfected wastes)
PO_4:	Russian River			0.40 mg/l (Russ. R.)
Chlorine Residual: (north of Tomales Bay)				0.1 mg/l max. (disinfected wastewaters)

1. From Ref. 7 and Ref. 6.
2. From Hydrology Data: 1970, Volume III: Central Coastal Area, Calif. State Dept. of Water Resources Bulletin No. 130-70, Dec. 1971
3. Refs. 12 and 14, for surface waters only.

b. Soils

The soils of Site 18 represent another kind of typical complex mix of the azonal soils of mountains and geologically young mountainous valleys. There are some lithosolic (stony, gravelly) soils and some regular or alluvial soils. They are very generally classified as chestnut and brown type warm, dry soils, with nearly black, friable, organic-rich topsoils and subsoils without any large accumulations of calcium carbonate or gypsum (Ref. 2). The mean annual soil termperature is over 47°F. There is little evidence of any development toward the stratification typical of either the podzolic soils typical of the geologically older mountainous and/or coniferous forest regions or the chernozemic soils typical of geologically older grasslands. More detailed soil information concerning the specific identified soil associations found in Site 18 is presented in Tables V-A-2,3,9, and 10 (background reference Section A-3c, Refs. 10d, 10h.)

The largest soil grouping is composed of grayish-brown, light to coarse textured, generally acidic loam topsoils and brown to yellow-brown, acid clayey subsoils. They cover about 61 percent of the surface area of Study Site 18. They are derived from soft, sandstones, weathered fine grained hard sandstones from the Franciscan-Assemblage (with some shale inclusions), and mixed soft and hard stones with some shale inclusions. These soils are found in elevations ranging from 100 feet to 1500 feet; in gently sloping, undulating, to very steep dissected marine terraces, very steep uplands, in low smooth rolling hills and the steep hillsides of the more rugged but low mountainous areas. There is definite evidence of a tendency toward pronounced erosion, particularly in areas where the slopes are over 15 percent. Their topsoils consist of strongly acid dark gray sandy loams and loams, medium acid grayish brown clay loams, medium-to-strong acid dark grayish brown loams and silty loams, slight-to-medium acid grayish brown loams, and strongly acid light brownish gray fine sandy loams. Their subsoils consist of medium acid yellowish brown sandy clays and clays, neutral olive brown clays, medium acid light grayish brown to mottled yellowish brown sandy clays, and strongly acid brown clay loams and pale yellow sandy clays. Substratum consists of weathered sandstone, fractured hard sandstone with some shale, brownish yellow sandy clay mixed with some soft consolidated sands (at depths of 30-48 inches), very strongly acid pale brown sandy clays mixed with fine grained softly consolidated sands (at depths between 20-40 inches), and very strongly acid pale brown weathered soft sandstones. This soil grouping includes, in order of importance, the Los Osos, Steinbeck-Los Osos, Goldridge, and Rohnerville-Kneeland associations.

The second largest soil grouping is composed of light brown to grayish brown somewhat gravelly, and generally acidic loam topsoils and

darker, brown to reddish brown, somewhat more acid and more clayey loam subsoils. They cover just under 18 percent of the surface area of Site Area 18 and are found in all sub-areas. They are derived from weathered fine grained hard sandstones of the Franciscan Assemblage and from shales of similar geological age. These soils are also found in elevation ranging from 100 feet on up; on steep to very steep uplands primarily (800 feet on up). Most of the soils in this group are associated with coniferous timber vegetative cover. Topsoils consist of medium acid pale brown very gravelly loams, strongly acid grayish brown loams, medium acid brown loams, and slightly acid to neutral sometimes gravelly brown to reddish brown loams and clay loams. Subsoils consist of medium acid pale brown to brown very gravelly loams, medium acid to strongly acid pale brown to dark yellowish brown loams, medium acid light reddish brown clay loams, and medium to strongly acid reddish brown clay loams and light clays. Substratum consists of weathered and shattered yellowish brown sandstones and shales at 30 to 60 inches depth, weathered finely grained sandstone at 25 to 40 inches depth, weathered sandstone and shales at 24 to 60 inches depth, and metasedimentary fine grained sandstones at 20 to 40 inches depth. This soil grouping includes, in order of importance, the Hugo-Laughlin-Josephine, Hugo-Josephine, and Laughlin-Parrish associations.

The third largest soil grouping (regosoles) is composed of young soils with coarse to medium texture which have developed on recently deposited alluvium in the level to gently sloping fans and floodplains of Study Site 18. This soil grouping covers about 10 percent of the Site Area and is scattered throughout, mostly in elongated, essentially narrow valleys. Finer textured soils are usually found in the downstream reaches. Most of these soils are derived from materials eroded from soft sedimentary coastal sandstone hills which include mixtures with fine grained hard sandstones and shales. Topsoils consist of grayish brown to dark gray fine sandy to clay loams, about 30 inches deep, together with some strongly to very strongly acid grayish brown loams and clay loams and neutral clay and silty loams. Subsoils are composed of poorly drained mottled dark gray silty clay loams together with some medium acid brown to yellowish brown gravelly clay loams and gravelly sandy clay loams, and neutral dark grayish brown angular blocky structured clays. This soil grouping includes primarily the Pajaro association together with the Pleasanton-Zamora association.

c. Climatology and Meteorology

The climate of Study Site 18 is characterized by moderate temperatures and precipitation. Air temperatures range from about 44°F in January

to 56-60°F in July with night temperatures usually dropping into the low 50's during the warm season. Mean annual precipitation, pan evaporation, potential evapotranspiration, and vegetative requirements for the four sub-areas of the Site are shown in the following (from Table V-A-4):

Mean Annual:	Site 18 Sub-Areas			
	18.1	18.2	18.3	18.4 18.5 18.6
Precipitation	34.0"	44.0"	35.2"	37.2"
Pan Evaporation	57.6"	57.6"	57.6"	57.6"
Potential Evapotrans-piration	40.3"	40.3"	40.3"	40.3"
Vegetative Requirement	27.4"	25.9"	27.2"	27.6"

About 82 percent of the mean annual precipitation is concentrated in the months of November through March. About 64 percent of the mean annual pan evaporation occurs between May and September. Mean annual evapotranspiration from non-irrigated areas is about 20 inches with highs of about 25 inches being reported in the higher elevation of sub-area 18.3. The average length of the growing season is about 250 days without a killing frost in the northeast part of the Site and increases to just over 300 days in the southwesternly most part of the Site Area. Mean annual sunshine is about 2800 to 3000 hours per year. Sunshine is generally abundant during the summer except for considerable cloudiness and fog along the immediate coast. The summer dry period is generally long enough to deplete stored soil moisture and to produce dried range except in the immediate vicinity of the coast where the low clouds and drizzle at night may provide sufficient moisture to keep pastures green. Winds are relatively light most of the time and generally blow persistently off the ocean during the summer, and especially so in the near coastal areas. The deflecting of marine air masses by elements of the coast mountains in the summer diminishes the cooling effect of these air masses and results in generally higher temperatures inland of these mountains. (Refs. 2,6,10d, 10h, 12.)

Summary of Air Quality Conditions: It is estimated that Site 18 currently experiences less than 10 days per year where oxidant levels are at or above 0.10 ppm. Background discussion for this has been presented in Section A-3d. The site's coastal location, generally prevailing winds off the ocean from the west, mountains separating it from more developed areas to the south and to the east, and its own relative lack of industrial and residential development apparently insure these high air quality conditions. No significant degradation is expected in the immediate future. (Ref. 142.)

3 - Environmental Setting Without the Project: Ecological

a. Vegetative Cover

Wastewater Application Site Area 18 (Marin and Sonoma Counties) support five major vegetative cover types: agriculture, chaparral (brush), grasses and forbs, hardwoods (oak, woodlands and mixed evergreen forest), and coniferous forest (Figure V-D-6). The agricultural vegetative cover type is represented by orchards (apples) and pasture (dairy) in the eastern portions of the study area. The agricultural areas of the western and central portions of the study area are in pasture. The grasses and forbs are also used for grazing.

The grasses and forbs have for many years been used for grazing. As a result of this pressure, the original perennial bunch grasses have been replaced by annual "weedy" grasses. Much of the present grasslands were at one time brush or forest areas. The redwood and mixed evergreen forests covered a substantially greater portion of Site 18 than they now cover. The grasses and forbs cover is the largest cover type found in Site 18.

Chaparral brush areas of Site 18 are predominately chaparral broom (<u>Baccharis</u> <u>pilularis</u>). <u>Baccharis</u> <u>pilularis</u> is found in both coastal and inland areas (Figure V-D-6). Brushy areas occur in several forms; as dense cover, mixed with grasses and forbs, as a riparian species, or as an occasional bush in forest and woodland areas.

The hardwood forest is represented by two plant associations - oak woodlands and mixed evergreen forest. The dominant agencies in these associations, as well as in the other vegetative cover types, are listed in Table V-D-2. The oak woodland is associated with the grasslands; occurring in ravines, on hilltops, or in large groves. The mixed evergreen forest is associated with the redwood (coniferous) forest. Some areas marked (Figure V-D-6) "coniferous forest" may be mixed evergreen stands or mixed evergreen stands with a few redwoods. The oak woodland vegetative cover type is found in the interior regions of Site 18. The mixed evergreen forest is supported in the north and south quarters of Site 18 near the Russian River and Samuel P. Taylor State Park.

The coniferous forest areas of Site 18 are redwood forest. The redwood forest has not been lumbered out in the recreational region south of the Russian River. Redwood forest is also supported in and adjacent to Samuel P. Taylor State Park. Riparian vegetation (Table V-D-2) in the grassland areas is predominately willows. In forest and woodland areas,

Figure V-D-6

EXISTING VEGETATIVE COVER IN SITE 18

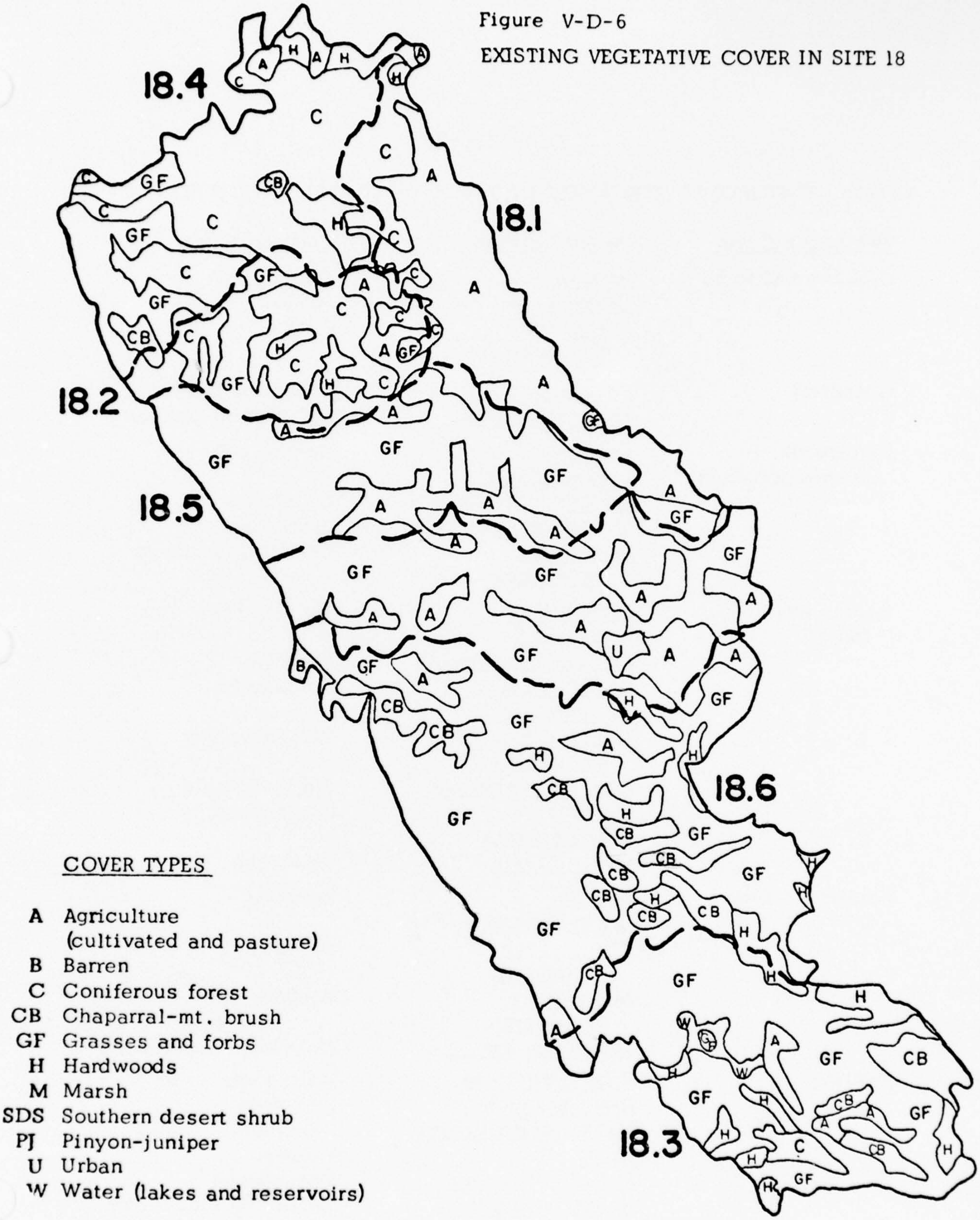


Table V-D-2

DOMINANT NATIVE VEGETATION OF WASTEWATER APPLICATION SITE 18

Vegetative Cover	Scientific Name	Common Name
Grasses and forbs	Bromus ssp.	Chess
	Festuca ssp.	Fescue
	Avena ssp.	Oats
	Other grass species	
Chaparral	Baccharis pilularis	Chaparral broom
	Rubus vitifolius	California blackberry
Hardwoods (oak-woodlands)	Quercus chyrsolepis	Canyon oak
	Q. agrifolia	Coast live oak
	Q. kelloggii	Black oak
	Aseculus californica	California buckeye
(Mixed evergreen forest)	Lithocarpus densiflora	Tanbark oak
	Arbutus menziesii	Madrone
	Pseudotsuga menziesii	Douglas fir
	Unbellularia californica	California bay
	Acer macrophyllum	Big leaf maple
	Quercus chyrsolepis	Canyon oak
	Q. kelloggii	Black oak
Coniferous forest	Sequoia sempervirens	Redwood
	Pseudotsuga menziesii	Douglas fir
	Lithocarpus densiflora	Tanbark oak
	Vaccinium ovatum	California huckleberry
Riparian	Vitis californica	Wild grape
	Alnus oregona	Red alder
	Sambucus callicarpa	Elderberry
	Salix spp.	Willow
	Populus fremontii	Cottonwood
	Rubus vitifolius	California blackberry
	Acer negundo ssp. californicum	Box elder

willows and alders form the predominant vegetation. Some of the grassland streamsare devoid of any riparian vegetation with the exception of grasses. Rare, endangered and possibly extinct plant species of this area are included in Table V-D-3.

b. Fish and Wildlife

Fisheries: Site 18 has freshwater, saltwater, and brackish water fisheries. The Russian River is the major stream of the area.

Anadromous Fish. Chinook (King) salmon (500 fish), Coho (silver) salmon (5,000 fish), and steelhead (50,000 fish) are estimated to use the river and its tributaries. Ten thousand angler-days/year with a yield of 0.2 fish per angler-day for salmon and 60,000 angler-days per year with a yield of 0.2 fish per angler-day for steelhead indicate the recreational use of this fishery on the Russian River.

In Site 18 the following streams are important coho salmon and steelhead streams: Salmon Creek, Walker Creek, Lagunitas Creek, Stemple Creek, and Nicasio Creek.

Minor streams of Sonoma County are reported as having 34 miles of silver salmon stream habitat, 1,000 spawners, and a 0.3 fish per angler-day yield; and 48 miles of steelhead streams, 4,000 spawners, and a 0.3 fish per angler-day yield. The minor streams of Marin County have 92 miles of silver salmon habitat, 5,000 spawners, 1,600 angler days, and a yield of 0.3 fish per angler-day; and 108 miles of steelhead habitat, 8,000 spawners, 3,700 angler-days and a yield of 0.3 fish per angler-day. The preceding data is for the entire Marin and Sonoma Counties.

Warmwater Fish. A warmwater fishery exists in the Russian River and its tributaries, especially downstream from Healdsburg. See Appendix Chapter K for a complete list of all warmwater fish occurring in Site 18. Some non-game "rough fish" such as carp and squawfish present a serious problem to the warmwater and anadromous game fish of the area. Carp commonly "root" up the bottom of waters making them muddy. Squawfish prey upon young steelhead in the Russian River.

Estuarine. Tomales Bay contains a premium inshore fishery. Flatfish, perch, smelt, and rock fish families represent some of the common fish found in the bay. See Appendix Chapter K for a more complete list of the inshore fishes occurring in Site 18.

Table V-D-3

WASTEWATER APPLICATION SITE 18
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species	Local Habitat	Plant Community
Sonoma County		
Campanula californica	Near coast	Freshwater marsh
Carex albida	Open marshy places below 300 feet	Mixed evergreen forest
Rhynchospora californica	Bogs, Ledum swamp	
Arctostaphylos bakeri (Stanford manzanita)	Dry serpentine ridges near Camp Meeker and Occidental	
A. densiflora (Sonoma manzanita)	Banks, along roadside 10 miles west of Santa Rosa	
Agrostis blasdalei (Bent grass)	Near coast	Coastal strand (dunes)
		Northern coastal scrub (cliffs)
Calamagrostis bolanderi		Freshwater marsh
		Meadows in closed-cone pine forest
		Northern coastal scrub
C. crassiglumis	Swampy places	Freshwater marsh
		Northern coastal scrub
Lupinus abramsii	Open woods	Mixed evergreen forest
	2000-5000 feet	Yellow pine forest
Trifolium amoenum	Rare, in low rich fields, swales	

Table V-D-3 (continued)

WASTEWATER APPLICATION SITE 18
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species	Local Habitat	Plant Community
Fritillaria liliacea	Heavy soil, open hills and fields	Northern coastal scrub
	Near coast	redwood forest
Lillium maritimum (Coast Lily)	Sometimes in sandy soil, usually on raised hummocks in bogs. Also in brush and woods, at low elevations	Northern coastal scrub Northern coniferous forest
Linnanthes vinculans	No data	
Eriogonum caninum	Dry rocky slopes on shale or serpentine	Coastal prairie
	1000-2000 feet	
Delphinium bakeri	Low brush and fence rows, below 600 ft.	Valley grassland
	Coleman Valley	
D. luteum	Open places on sea bluff	Northern coastal scrub
	Bodega region	
Ceanothus gloriosus	Sandy places	Coastal strand
		Closed-cone pine forest
		Northern coastal scrub
Castilleja latifolia	Sandy places	Coastal strand
		Closed-cone pine forest

Table V-D-3 (continued)

WASTEWATER APPLICATION SITE 18
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species	Local Habitat	Plant Community
Marin County		
Plagiobothrys glaber	Salt and alkaline flats	Coastal salt marsh
Campanula californica	Freshwater swamp	
	Point Reyes National Seashore	
Chaetopappa bellidiflora	Open dry rock slopes	Northern coastal scrub
		Coastal prairie
Streptanthus batrachopus	Serpentine outcrops, below 2000 feet	Chaparral
	Carson Ridge	
Rhychospora californica	Bogs, Ledum swamp	
Arctostaphylos montana	Serpentine flats and slopes	Chaparral
A. virgata (Bolinas manzanita)	Brushy slopes at edge of closed-cone pine forest	redwood forest
Agrostis aristiglumis (Bent grass)	Diatomaceous shale	
	West of Mt. Vision	
	Pt. Reyes National Seashore	
Agrostis blasdalei	Dunes	Coastal strand
	Cliffs	Northern coastal scrub

Table V-D-3 (continued)

WASTEWATER APPLICATION SITE 18
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species	Local Habitat	Plant Community
Calamagrosits crassiglumis (Reed grass)	Swampy places	Freshwater marsh
Pleuropogon hooverianus	Meadows	Mixed evergreen forest
Trifolium amoenum	Rare - in low rich, fields, swales	
Fritillaria liliacea	Heavy soil, open hills and fields near coast	Northern coastal scrub Redwood forest
Lilium kelloggii	Dry rocky places or shaded deeper soil Below 3500 feet	Redwood forest Mixed evergreen forest
Lilium maritimum	Sometimes in sandy soil, usually on raised hummocks in bogs. Also in brush and woods, at low elevation	Northern coastal scrub Northern coniferous forest
Sidalcea hickmanii ssp. viridis	Big Carson Ridge	Chaparral
Chorizanthe valida	Sandy places	Northern coastal scrub
Eriogonum caninum	Dry rocky slopes on shale or serpentine 1000-2200 feet	Coastal prairie
E. nortonii	Dry rocky slopes Inner coast range 1500-4000 feet	Chaparral

Table V-D-3 (continued)

WASTEWATER APPLICATION SITE 18
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species	Local Habitat	Plant Community
Polygonum marinense	No data	
Delphinium bakeri	Low brush and fence rows, below 600 ft.	Valley grassland
	Tomales	
Ceanothus gloriosus	Sandy places	Coastal strand
		Closed-cone pine forest
		Northern coastal scrub
Cercocarpus traskiae	(insular?)	
Castilleja latifolia	Sandy places	Coastal strand
		Closed-cone pine forest
Cordylanthus maritimus		Coastal salt marsh

In Site 18 the following streams are important coho salmon and steelhead streams: Salmon Creek; Walker Creek, Lagunitas Creek, Stemple Creek, and Nicasio Creek.

Minor streams of Sonoma County are reported as having 34 miles of silver salmon stream habitat, 1,000 spawners, and a 0.3 fish per angler-day yield; and 48 miles of steelhead streams, 4,000 spawners, and a 0.3 fish per angler-day yield. The minor streams of Marin County have 92 miles of silver salmon habitat, 5,000 spawners, 1,600 angler days, and a yield of 0.3 fish per angler-day; and 108 miles of steelhead habitat, 8,000 spawners, 3,700 angler-days and yield of 0.3 fish per angler-day. The preceding data is for the entire Marin and Sonoma Counties.

Warmwater Fish. A warmwater fishery exists in the Russian River and its tributaries, especially downstream from Healdsburg. See Appendix Chapter K for a complete list of all warmwater fish occurring in Site 18. Some non-game "rough fish" such as carp and squawfish present a serious problem to the warmwater and anadromous game fish of the area. Carp commonly "root" up the bottom of waters making them muddy. Squawfish prey upon young steelhead especially in the Russian River.

Estuarine. Tomales Bay contains a premium inshore fishery. Flatfish, perch, smelt, and rock fish families represent some of the common fish found in the bay. See Appendix (Chapter K) for a more complete list of the inshore fishes occurring in Site 18.

Estuarine-dependent species comprise a substantial part of the California marine sport catch. During 1958 and 1959 an estimated 24 percent, or one million pounds, of the average sport fishing catch was made up of estuarine-dependent species.

Tomales Bay is an important sport clamming area. Clams most sought by sportsmen include Washington, gaper, geoduck, little-neck, and softshell. During favorable tides, there are more than 300 clam diggers in the area. Commercial Pacific oyster enterprises exist in Tomales Bay, and a potential for expanding production is possible.

Wildlife: There are 10 wildlife habitat types found in Area 18. They are coastal forest, woodland grass, grassland, agriculture, chaparral, hardwood, marsh, tidal flats, lakes, bays, and reservoirs. Many species of wildlife are common residents in this area. Tomales Bay is an important habitat for shore birds and wading birds, and it provides resting and feeding areas for migratory waterfowl. The bay is an important feeding ground for

many inshore fish and a nursery for their young. During a two-day survey of Site 18, 38 birds and 3 mammalian species were identified. They are listed in Table V-D-4. Lists of all the vertebrate species whose distribution include Site 18 are contained in the Appendix, (Chapter K).

Big Game. Blacktail deer are common over the entire county of Marin in densities of 60 to 100 per square mile in hardwood and grassland habitat types, and 30 to 60 per square mile in other habitat types. Fallow and spotted deer herds occur in Marin County in the woodland grass habitat type in densities less than 10 per square mile. They are from private herds allowed to roam in wildland.

Particularly good deer areas are located in Hick's Valley, Chileno Valley and Atascadero Creek. Hunter bag of deer for Marin County was 1,200 in 1970, and for Sonoma County it was 2,800. These buck kills are the lowest since 1945; the major factors affecting this are reduction in hunting pressure and the closure of some land to hunting.

Black bear and mountain lion occur, but are not abundant in Site 18. Black bear prefer the coastal and coniferous forest, while mountain lion are more secretive and follow the major deer herds.

Wild boar and feral pigs occur in the area in small numbers. Their favored habitat would be ravines and canyons with dense brush where they root for bulbs, insects, and root and scavenge for other foods.

Upland Game. California valley quail range over the entire Marin County area and most of Sonoma County. Densities of 64 to 640 per square mile occur in the woodland grass, hardwood and grassland habitat types. Densities of more than 640 per square mile may occur in favorable chaparral areas. Riparian brush and chaparral are prime quail nesting and feeding areas. According to the California Department of Fish and Game there is "moderate potential for expanded use" of quail populations (Ref. 37).

The coastal forests zone contain breeding and wintering populations of band-tailed pigeons. Wintering population densities of 64 to 640 per square mile occur locally in Sonoma County. Doves are common in woodland grass and other habitat types in Marin County. Gray squirrels are common in densities of less than 64 per square mile, particularly in oak woodland and riparian areas. Mountain quail occur in the coastal forest areas. A few blue grouse are found in Sonoma County.

Brush rabbits are found in the coastal brush areas, brushy ravines, and riparian habitat. Large numbers of these animals may occur in suitable brushy areas. Jackrabbits occur on the coastal plains and on pasture

Table V-D-4

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS ON OCTOBER 19-20, 1972 OF WASTEWATER LAND APPLICATION STUDY SITE 18

Birds	Mammals
Pied-billed grebe	Gray fox
Western grebe	Gray squirrel
Common loon	Blacktailed deer
White pelican	
Pelagic cormorant	
Great blue heron	
Green heron	
Ruddy duck	
Greater scaup	
Surf scoter	
Mallard	
Turkey vulture	
Prairie falcon	
American kestrel	
Red-tailed hawk	
California valley quail	
Common coot	
Willet	
Northern phalarope	
California gull	
Mourning dove	
Barn owl	
Belted kingfisher	
Red-shafted flicker	
California acorn woodpecker	
Common raven	
Common crow	
Scrub jay	
Stellar's jay	
Black capped chickadee	
Wrentit	
Common bushtit	
Bewick's wren	
Loggerhead shrike	
Meadowlark	
Brewer's blackbird	
Red-winged blackbird	
Oregon junco	
House finch	
Song sparrow	
White-crowned sparrow	

or grazing land.

Waterfowl. Tomales Bay and associated lagoons and marshes support a myriad of water-associated birds. The diving duck species are particularly common in the bay. Species such as canvasback, goldeneye, bufflehead, scoters, and scaup are concentrated locally in densities of 640 to 6,400 per square mile in the winter months. Dabbling ducks are also common on other wetlands in Site 18. Tomales and Estero Americano Bays are two of the most important wintering areas for black brant geese in California. Eel grass beds found in the bays are the primary food source of wintering black brant. Peak population numbers occur in February and March when the geese are moving north from southern wintering grounds.

Non-game Wildlife. Shore birds are abundant on marsh lands and tidal flats. Great blue herons and common and snowy egrets can be observed feeding in shallow water, especially at low tide. Shore birds such as willets and dowitchers probe the exposed tidal mudflats for food.

Sea fowl are abundant in the deep water areas of Tomales Bay. Cormorants and western grebes can be observed diving for fish. Coots are omnipresent, swimming in small and large groups.

Marin County is one of the best localities for observing the osprey and white-tailed kite. In Sonoma County kite populations occur in densities of about 6 per square mile in grassland and agricultural types.

Ninety percent of the diving ducks wintering in California are limited to the coastal zones. Eighty to ninety percent of our 33 species of shore birds pass through or winter on the California coast. Tomales and Estero Americano Bays represents a significant portion of the coastline available to waterfowl and water associated birds.

Rare and Endangered Species: Twenty-one species of rare or endangered animals are thought or known to occur in Site 18 as classified by state and federal lists (see Appendix, Chapter K). They are listed in Table V-D-5.

Other species known to be having survival difficulties, but not listed as rare or endangered are:

Common Name	Key Remarks
Cormorant, Brants'	Experiencing reproductive failure
Cormorant, pelagic	Experiencing reproductive failure
Murre, common	Numbers decreasing

Table V-D-5

RARE AND ENDANGERED SPECIES OF SITE 18

Common Name	Status	Occurrence
Fish		
White sturgeon	U	x
Reptiles		
Alameda Striped racer	R	x
Birds		
California brown pelican	E, U	x
Aleutian Canada goose	E	*
Tule white-fronted goose	E	*
Red-bellied red-shouldered hawk	E	*
Ferruginous hawk	U	x
Southern bald eagle	E	x
American osprey	U	x
Prairie falcon	R	x
American peregrine falcon	E	x
Greater sandhill crane	R	x
California clapper rail	R, E	x
California black rail	R	x
Mountain plover	U	x
Alaskan short billed dowitcher	U	*
California least tern	E	x
California yellow billed cuckoo	R	x
Northwestern tropical kingbird	U	x
Yakutat fox sparrow	U	x
Mammals		
Southern sea otter	R	x

Table V-D-5 (continued)

RARE AND ENDANGERED SPECIES OF SITE 18

NOTE:

E Endangered

R Rare

U Status uncertain

x This species or subspecies definitely or probably occurs on the wastewater management area.

* Occurrence of this species or subspecies on the wastewater management area is uncertain or questionable.

Fish. White sturgeon were once abundant in the Sacramento-San Joaquin drainage and to a lesser extent in the Russian River. Present numbers are lower than they have been historically. Sturgeon are easily over fished (Ref. 90). They are not at present considered rare or endangered.

Reptiles. The Alameda striped racer usually occurs in chaparral, but may be found in woodland or grassland. Present habitat is the east San Francisco Bay area. Urbanization and development of habitat are primarily responsible for declining populations.

Birds. The California brown pelican has been experiencing reproductive failures due primarily to pesticide poisoning. Only 7 young were produced out of 600 nesting attempts by brown pelicans in California in 1971. The birds occur on Pacific Coast from Canada to Mexico (Ref. 36).

The Aleutian Canada goose and the tule white-fronted goose are winter visitors to the California coast. Little information is presently available on these two goose species.

The hawks and falcons listed as rare or endangered share a common denominator for their plight. Persistent pesticides have caused reproductive failures in southern bald eagle, American osprey, and American peregrine falcon populations. Reduction of habitat by human encroachment on feeding and nesting areas, and shooting by irresponsible individuals have added to the plight of these raptorial (bird of prey) species (Ref. 36). One prairie falcon was observed at Goat Rock State Beach on the Sonoma County coast on October 19, 1972. This beach is adjacent to the northwestern boundary of Site 18.

The California clapper rail and the California black rail are marsh associated birds. Reduction of salt marshes by draining and filling, industrial pollution and the black rat continually threaten the existence of the California clapper rail. The California black rail once occurred from Tomales Bay south in salt marshes. Reduction of habitat is the most serious threat to the survival of this species.

The Alaskan short billed dowitcher is a winter visitor to the California coast. Mudflats and exposed tidal areas are important winter feeding areas. The California least tern requires solitary sandy beaches for breeding success. Habitat destruction, human disturbance, and predation may be responsible for the rapidly declining population.

The California yellow billed cuckoo inhabits dense riparian vegetation, especially willows. Urbanization and land use changes are primary reasons

for decline in its habitat.

Mammals. The southern sea otter once commonly occurred throughout the northern California coast. Incessant hunting reduced populations to a critical level, but populations are rebuilding and concentrations of otters occur in some localized areas.

Wildlife and Fish Diseases. Lungworms and stomach worms are common parasites of the deer or Site 18. Two kinds of lungworms are found in the deer, Dictyocaulus sp. and Parelaphostrongylus odocoilei.

The life cycle of Dictyocaulus is direct where the eggs are coughed up from the lungs, swallowed, and passed out with the droppings. After the eggs hatch, larval forms develop which are picked up with food; the larvae penetrate the intestinal wall to find their way to the lungs where they mature. At times there are so many worms in the bronchioles that the air passages are completely blocked. These deer die of a verminous pneumonia . Lungworms have been responsible for high deer losses (Ref. 115).

Parelaphostrongylus has a more complicated life cycle which involves snails or slugs that are parasitized by the larval form. The deer eat the infected molluscans and the larvae mature into adult worms in the deer muscles. The worm's eggs and first larvae are passed in the blood stream to be deposited in the lungs where pneumonia can develop if there are sufficient numbers of eggs and young forms (Ref. 116).

Another groups of internal parasites of deer which are commonly infected on Area 18 have been categorized as "stomach" worms. In actuality these worms occur in the fourth stomach, cecum and intestines. There are at least 11 species involved; some of the more serious ones are Oesophagostomum venulosum, Ostertagia circumcincta and Nematodirus filicollis (Ref. 115). Transmission is direct as the eggs pass out with the droppings, and hatch, and the larvae crawl on blades of grass to be eaten by deer. These nematodes burrow into the walls of the stomach or intestine of the deer and feed on blood. Individual deer may have more than 30,000 stomach worms which cause the animal to become anemic, and fatally debilitated. Stomach worms are responsible for the greatest loss of deer in California.

The number of deer deaths fluctuate from year to year according to forage conditions and the amount of precipitation. The presence of sheep on much of this range allows an interchange of the roundworms between sheep and deer. Sheepmen drench their flocks to control the nematodes, but those pastures which are exposed to more rainfall continue to carry larvae which have originated in either the deer or sheep. Parasite infection is most common during late winter when the grass is green and the larvae have a better change of survival (Ref. 117). Continual irrigation of

pastures during the summer by application of wastewater would create difficulties in parasite control for the sheepmen. The stomach worm and lungworm problems in deer could be exascerbated, especially in Sub-Area 18.3 and 18.6 where forests and pasture will be contiguous.

Another problem common to sheep and deer, but of more serious consequence to sheep, is infection with the liver fluke Pasciola hepatica (Ref. 111, 115). This parasite has a complex life cycle which involves a larval form finding its way into freshwater snails where further developmental stages occur; the larvae escape from the snail and undergo another change; then finally larvae crawl on blades of grass, encyst and await ingestion by sheep or deer. The cysts are capable of survival during short dry periods. Young flukes reach the liver by passing through the digestive tract wall. Deer and cattle successfully wall off the fluke in the liver, but flukes cause severe damage to sheep and subsequent high mortality rates. There is an economic loss in marketed cattle since their livers are condemned. Streams that pass through or ponds within the pastures contain the intermediate snail hosts. Control of the snails by application of copper sulfate has been practiced, but this chemical is extremely toxic to fish. The molluscacide must be applied with great care and only where sufficient dilution would occur prior to contact with fish. In some situations copper sulfate cannot be used.

Liver fluke is fairly common on much of Site 18. Application of wastewater to this site could increase the damage caused by this parasite. If intermittent streams were changed to continual flow, conditions would be created favorable for an interruption of the molluscan intermediate hosts of liver fluke. Small swales with standing water on a year round basis would also increase the snail population. These changes in the ecosystem must be weighed carefully.

Anaplasmosis is a disease of cattle caused by Anaplasma marginale. This parasite invades and destroys red blood cells thereby causing a severe anemia which leads to death of cattle. Although there is a relatively high incidence of the disease, the effects in deer are insignificant because of an innate resistance. Mortality may run as high as 50 percent in cattle. The disease in deer is of importance because they are latent carriers of the infection. Transmission may be accomplished by ticks, horseflies or mosquitoes as well as other biting insects (Ref. 118, 119).

Practically all infected deer recover and remain carriers for possibly their lifetime. The U. S. Department of Agriculture had to abandon a crash program aimed at eradication of anaplasmosis because of the prevalence of carrieres among deer populations.

Although the tick is the most important vector of anaplasmosis, transmission by mosquitoes is a factor which could complicate wastewater application on Site 18. Management of wastewater should be conducted in a manner which would not encourage mosquito breeding.

No other diseases of wildlife now present or anticipated would be influenced by the application of wastewater on Area 18.

Fish Diseases and Parasites. The fish diseases and parasites found in Area 18 will be essentially the same as those found in Site 4. Special consideration must be given to diseases of salmonids (SRCD, "whirling disease and IPN) in this area. The Russian River and the numerous coastal streams found in this area are important migration routes and spawning areas for chinook and coho salmon, and steelhead rainbow trout. Refer to the discussion of fish diseases and parasites found in the present environment section of Site 4.

c. Ecological Systems

The high biological productivity of estuaries results from organic-laden freshwater mixing with nutrient-laden sea waters. Through tidal changes and currents, a constant fresh supply of sea water enters an estuary. Streams entering estuaries perform an important function in maintaining salinity balances. The "transition zone" where salt and freshwater meet supports a most diversified invertebrate fauna; and therefore, constitutes a critical feeding areas for fish and water associated birds.

The coastal bays and estuaries within Area 18 are all important wildlife areas. These areas have delicately balanced ecosystems which are highly susceptible to man's influence, especially kelp beds (important fish cover). The addition of water (even of the best quality) could be detrimental to a waterway if the outlet was a coastal bay or estuary. Changes in salt concentration or composition in near shore waters could affect the animal community.

Water of high quality is a necessity in coastal streams used by anadromous and resident fish. The streams must allow passage of adult fish upstream and juvenile fish downstream. Spawning areas must be clean and free of siltation and debris. Developing eggs need a constant oxygen supply, and proper water temperature and must be relatively free from diseases.

There is a great diversity of terrestrial wildlife in Site 18. They include the coastal marshes, tidal flats and estuaries, the coastal plains with interspersed areas of brush and trees and the coniferous forests of the inner coast range.

The marshes and tidal flats support numerous wading and shore birds. Tidal flats exposed at low tides provide feeding areas for dowitcher and whimbrels, which probe the mud for food. Herons and egrets feed on fish and invertebrates appearing in shallow water and pools stranded at low tides.

Cormorants and grebes dive for fish in the deeper water zones in Tomales Bay. Migrant waterfowl, such as black brant, geese and ducks rest and feed on Tomales and Bodega Bays.

Marsh associated mammals, such as mink, raccoons and weasel may be found on the edges of the marshes.

The terrestrial vertebrates of the estuaries depend either directly or indirectly upon the aquatic life found within the estuary. Any alteration of the estuarine ecosystem (change in freshwater inflow, tidal flushing action, or salinity) may result in changes in the species composition, abundance and diversity of estuarine organisms.

The coastal plains, primarily grasses interspersed with brush and trees, support many wildlife species. Songbirds such as meadowlarks, spend their entire life cycle in the grass of the coastal plains.

Other animals, such as deer, frequently use the grassland as feeding areas. Coastal deer graze on the young, tender shoots of grasses when they are available, while utilizing some brush plants as browse forage and cover. Raptorial bird species such as red-tailed hawks, prairie falcons, and American kestrel spend much time foraging over grassland.

Brush "islands" that occur in grassland areas provide cover for wildlife, while the grassland provides feeding and foraging areas. Brush rabbits and California quail commonly occur in the "edges" created between brush and grassland. Small mammals such as mice, ground squirrels and gophers are common in the grassland areas. These small mammals form an integral part of the food web for the larger carnivores (foxes, coyote, hawks). A change in the species composition of grasses in these areas could affect the kind and abundance of small mammals and birds associated with grasslands. This, in turn, could alter the feeding habits of the larger predators, causing increases or declines in populations depending upon the ability of the predators to adapt to new forage species.

The coniferous forests occur on the higher elevations of the coast range and in valleys where they have not been cut.

Birds may occupy different levels in the forest zones. Many birds nesting areas are found in the forest canopy or in the brush on the forest floor.

Although, the ground level is utilized by many bird species as a forage area. Deer may be commonly seen in forests, but forage will be resticted to brushy and grassy areas.

The penetration of light will affect the abundance and distribution of brush in forest areas. Any increase in brush species in a forest will encourage an increase in the brush associated birds and mammals. The loss of coniferous forest habitat would reduce those animals that are intimately associated with the forests (i.e., stellar's jay, various warbler species). These species and probably others would be lost if the forests are seriously altered or removed.

Oak woodland and grassland areas occurring in the interior regions of Site 18 provide habitat for coastal blacktailed deer, foxes and coyotes, and numerous songbirds.

Riparian zones adjacent to streams provide cover for many animal species. Birds may be very abundant in riparian zones, especially where there is a mixture of trees, brush and annual plants. Kingfishers are common in riparian vegetation overhanging streams. Mammals, such as raccoons, opossums and weasels are common in streamside riparian zones. Riparian zones are concentration points for wildlife.

d. Recreation Resources

Site 18 receives heavy recreational use with a gross recreational user potential of 254 million visitor-days per year. Concentrations of recreationists occur along the Russian River and the coastal beaches.

An abundance of state, county and local parks provide both day use and overnight facilities for sightseers and outdoor enthusiasts from the Sacramento Valley and San Francisco Bay regions. Besides sightseeing, camping, hiking, horseback riding, swimming and boating, the area is also a popular fishing and hunting region. Popular game fish species include salmon, steelhead, shad and various warmwater fish. Game species include deer, quail, tree squirrel, dove, ducks and black brant.

Present Public Facilities: The list of public recreation sites in or around Site 18 is extensive. Tomales Bay State Park, Doran County Park, Westside County Park, and Bodega Marine Life Refuge are among the more important ones which are actually adjacent to, but outside, the boundaries of the study area. Monte Rio Park and Monte Rio Public Beach are both inside the area boundaries along Russian River,

Two additional facilities that are adjacent to, but outside Site 18 boundaries should be mentioned. Point Reyes National Seashore is just across Tomales Bay from the study area, while the Sonoma Coast State Beaches abut the area along nearly 7 miles of State Highway 1. The available facilities and activities of these two parks are listed in Table V-D-6.

The remaining recreation sites mentioned here are within Site 18. Samuel P. Taylor State Park is located along Lagunitas Creek in Marin County. Its primary activities are camping and picnicking; a complete listing of activities, facilities and estimated use is included in Table V-D-6. Sonoma County has developed a wayside park on one acre of land at historic Watson School near Freestone. The park is currently used as a roadside rest with picnic tables and sanitation facilities. Marin County has two additional public recreation sites in Site 18. Miller Park, on upper Tomales Bay, has a public boat ramp, picnic tables, and sanitation facilities. Nicasio Dam, a recent municipal water supply development, has multiple uses and facilities that are listed in Table V-D-6.

Rock and surf fishing, surf netting and scuba diving are popular recreational activities along the entire coast where public access is available. This is concentrated mainly along the Sonoma Coast State Beaches, Bodega Bay, and at the mouth of Tomales Bay.

Present Private Facilities: Sonoma and Marin Counties have been popular recreation and vacation areas for many years. The popularity of the coast and Russian River strips is made obvious by the concentration of park lands and resort and vacation establishments. Private recreational developments in the form of lodges, cabins, camps, boat landings and beaches occupy nearly the entire length of the Russian River, from Rio Dell to the river's mouth. The heavy development also branches out into the redwood regions along Bohemian Highway as far south as Occidental. A listing of all the private recreation sites in these area is beyond the scope of this project.

Private recreation developments located throughout the remainder of Site 18 are listed and described briefly below:

Marin County Motorcycle Association - motorcycle dirt track and picnic area on Marshall-Petaluma Road at Walker Creek (Gambonini Ranch)

Marshal kayak rental - kayak and small boat rental for use on Tomales Bay, located approximately 1 mile north of Marshall.

Private licensed pheasant club in Hicks Valley on Point Reyes-Petaluma Road.

Circle S Ranch - private licensed pheasant club at Tomales.

Table V-D-6

PRESENT PUBLIC FACILITIES IN OR IMMEDIATELY ADJACENT TO SITE 18*

		Activities								Facilities						Attendence		
Area	Acreage	Camping	Picnicking	Swimming	Riding-Hiking	Sightseeing	Boating	Hunting-Fishing	Other	Camp units	Picnic units	Parking	Boating Parking	Marina Slips	Trails (miles)	Year	Day Use	Overnight Use
Point Reyes National Seashore	64,546		x	x	x	x			x			275				1969	60,000	
																1980	72,600	
																1990	88,572	
																2000	101,857	
S.P. Taylor State Park	2,576	x	x		x	x			x	72	128	110				1969	135,005	53,392
																1980	163,356	64,604
																1990	199,294	78,816
																2000	229,188	90,638
Nicasio Dam - Marin County	1,522		x	x	x	x	x	x								1969	18,000	
																1980	19,300	
																1990	23,619	
																2000	27,161	
Sonoma Coast State Beaches	1,031	x	x		x	x		x		30								

(continued)

Table V-D-6 (continued)

PRESENT PUBLIC FACILITIES IN OR IMMEDIATELY ADJACENT TO SITE 18*

		Activities								Facilities						Estimated Visitor-days/year	
Area	Acreage	Camping	Picnicking	Swimming	Riding-Hiking	Sightseeing	Boating	Hunting-Fishing	Other	Camp units	Picnic units	Parking	Boating Parking	Marina Slips	Trails (miles)	Current	Year 2000
Tomales Bay State Park	1,000										35	165			2	127,800	200,200
Doran County Park	100									200		45				70,300	119,400
Westside County Park	100													70			
Monte Rio Park and Public Beach	100										6	500		35		175,000	297,100

* Adapted from Ref. 38

San Geronimo National Golf Course - 18 hole golf course and driving range on Sir Francis Drake Boulevard in San Geronimo.

Forest Fram Camps and Tumbleweed - 240 acre facility with camping, picnicking and swimming, located on Sir Francis Drake Boulevard near Lagunitas.

Dillon Beach - resort fishing facilities with boat and skiff launching and rentals, party boat operation and clam barge.

Private boat landings and their associated facilities are listed in Table V-D-7.

Hunter and Angler Use: Hunter use figures for the area are available only in county-wide totals. These figures, (shown in Table V-D-8) compiled by the California Department of Fish and Game in 1970, are estimates based on a 2 percent hunter survey.

Figures listed for deer kill in the Santa Rosa herd of the North Bay wildlife management unit indicate an average kill of 1,610 over the last three years. This management unit covers the entire area of both Sonoma and Marin Counties (Ref. 34).

Fishing in Site 18 is generally concentrated along the Russian River. Excellent salmon, steelhead and warmwater fisheries are present in the stream. Fishing use estimates are available for the main stem of the Russian River as well as the smaller coastal tributaries. The coastal tributary figures are given as county totals (from Ref. 32, warmwater fisheries information is not available).

	Salmon		Steelhead	
	Angler Days	Yield	Angler Days	Yield
Sonoma County	500	0.3	3,000	0.3
Marin County	1,600	0.3	3,700	0.3
Russian River	10,000	0.2	60,000	0.2

Open Space: Because two counties are involved, the open space proposals for the study area require two separate discussions. Sonoma County is currently rewriting their open space policy, so it is necessary to rely on a plan drawn up in 1964 to discuss the northern half of the area. Most of the open space in that area is classified as rural land. Urban-type development is expected to occur gradually, at present the land is agricultural with dairying being the dominant use. Smaller areas of watershed (all lands south

Table V-D-7

PRIVATE BOAT LANDINGS AND THEIR ASSOCIATED FACILITIES IN SITE 18 AREA*

	Launching	Berths	Mooring	Dry-storage	Accommodations	Camping	Picnic	Trailer
Tomales Bay								
Golden Hinde Boatel	x	x	x	x	x		x	
Inverness Yacht Club	x	x		x				
Lawsons Landing 1/	x		x	x		x	x	x
Marshall Boat Works	x		x	x				
Nick's Cove (Miller Park)	x						x	
North Shore Boatbuilding	x			x				
Marconi Cover Marina	x	x				x		
San Antonio Creek								
Mira Monte Fish Resort	x	x	x	x				

1. Occupies about 300 acres; contains 40 picnic units, 600 parking units; 35 boat slips, and 200 camping units.

* Adapted from Ref. 41

Table V-D-8

1970 HUNTER SURVEY - MARIN AND SONOMA COUNTIES*

	Marin		Sonoma	
	Bag	Hunters	Bag	Hunters
Pheasant	7,000	1,900	6,800	4,000
Quail	10,100	1,300	29,200	4,500
Dove	3,700	800	34,400	3,900
Pigeon	200	100	4,000	1,000
Jack rabbit	5,700	1,200	35,800	2,500
Cottontail	700	200	1,900	500
Tree squirrel	3,400	700	9,900	1,300
Ducks	33,700	2,500	35,100	3,300
Geese	3,300	700	500	200
Jacksnipe	1,300	200	5,400	900
Coots	16,000	900	11,900	500
Deer	1,200	2,300	2,800	7,500

* Extracted from unpublished records, California Department of Fish and Game, Sacramento, California.

of the Willow Creek drainage and west of Freestone), conservation area (lands roughly north of Occidental), and regional parks (proposed Willow Creek and Korbel Parks) are also recognized as open space. The conservation and park lands are being preserved for their scenic and recreational value while the watershed is set aside to preserve present water quality and quantity. The only Sonoma County land in Site 18 not designated open space is currently listed as commercial recreation area and urban area. This land lies along the Russian River (Ref. 92.)

Marin County's currently effective open space plan was developed in 1971. All study area lands within the county are being maintained in one of several open space categories except present and proposed urban lands at Tomales, Dillon Beach, Marshall, Point Reyes Station, Lagunitas, Forest Knolls, San Geronimo and Arroyo Nicasio Canyon. The coast of Tomales Bay and the bottom lands of Lagunitas Creek, Arroyo Nicasio, Halleck Creek, Walker Creek, Chileno Creek, Salmon Creek, Keys Creek, Estero de San Antonio and Estero Americano are being preserved as conservation areas. Regional parks are expected to form a corridor from Samual P. Taylor State Park to Nicasio Reservoir. The remaining lands within Site 18 are dedicated to agricultural open space, the most common present use being dairying (Ref. 67). The Marin County Open Space Plan is presently undergoing complete revision.

Future Public Facilities: Sonoma County has proposed two new recreation sites within the Site Area. A 200-acre plot of land at the mouth of Willow Creek on the Russian River is being considered as a regional park with picnic and camping facilities. Originally a larger park was planned in conjunction with the state, but logging and private recreational development on upper Willow Creek has made the area less desirable as a public park. The county also has plans for a wayside park on Estero Americano west of Valley Ford, but no development has yet taken place (Ref. 92).

The development of new recreational facilities in Marin County is currently under intense study. Present plans include three new sites within Site 18. A regional park at Millerton Point on Tomales Bay is being considered. This facility would include 200 to 300 acres of bayside land which the county seeks to preserve from urban and commercial development. The county is also planning to expand the limited facilities now available to Nicasio Reservoir; a 300 acre regional park is the ultimate goal for this site. Finally, Marin County is seeking to preserve a small portion of redwoods between San Geronimo and Nicasio Reservoir as a limited use recreational facility. Exceptional stands of virgin redwoods are present and are considered a rare and valuable scenic as well as recreational resource.

Two large-scale regional studies may influence the future of recreational facilities within the study area. The Conservation Foundation, through a Ford Foundation Grant, is studying the recreational and resource potential of Tomales Bay in order to set up priorities of use and preservation throughout the Bay. In addition a Golden Gate National Recreation Area has been approved, but not funded, by the federal government. This national recreation area would include most of coastal Marin County from the Golden Gate to Olema. Although this lies outside the study area, its presence would greatly alter priorities and proposals for park areas throughout Marin County (Ref. 82).

e. Protected Waterways Designation

The following Site 18 waterways have designations in the California Protected Waterways Plan.

1. Russian River - Class I scenic, fishery, wildlife, and recreation waterway. A Class I salmon, steelhead stream, and warmwater stream. In the fisheries waterways evaluation, it is classified as a Class II salmon river, a Class I steelhead river, and as Class II shad waters (mouth to Healdsburg Dam). It is also a Class I riparian land.

2. Tomales Bay - Class II very good scenic, fishery, wildlife, and recreation waterway. It is also classified as a Class I estuary.

3. Estero Americano and Estero de San Antonio - Class I lagoons. The lagoon of the Russian River is a Class II lagoon. Salmon Creek lagoon is Class III.

4. Atascadero Creek and Olema Creek - Class III marshes, and D-Ranch Pond (location unknown) Class III freshwater pond.

5. Olema, Salmon, and Pine Gulch (location unknown) creeks are designated as Class III steelhead streams in the fishery waterways evaluation.

Marin County included in the following Site 18 waterways in their list of waterways to be considered in the California Protected Waterway Plan:

Tomales Bay
Lagunitas-Halleck-Nicasio Creeks

Walker-Salmon-Chileno Stream System
San Antonio Creek
Estero Americano

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

The archaeological potential of Site 18 primarily reflects the historic and relatively heavy populations of Pomo Indians who inhabited the area. It is estimated that an archaeological site exists about every half-mile along any of the Site's many drainage channels (Ref. 11.)

Site 18 has four significant historical landmarks located within or immediately adjacent to its limits; three of them are registered State landmarks (Refs. 11, 15). The pioneer "Church of Our Lady of Loretto" is located within the community of Nicasio (Sub-Area 18.3 see Figure V-D-5c). The site of the first paper mill on the Pacific Coast (built in November 1856) is located within the Samuel P. Taylor State Park (Sub-Area 18.3) it is listed as California Registered Historic Landmark 552. California Registered Historic Landmark 820 is "St. Teresa's Church" located within the town of Bodega (Sub-Area 18.2). It was constructed of redwood in 1859 and it has served the community of Bodega continuously since its dedication in 1861. California Registered Historic Landmark 833 is Bodega Bay and Harbor. They were discovered by the Spaniards in 1602-03.

b. Scenic Locations

The officially designated scenic sites and areas of Site 18 are concentrated along the coast and along several coastal streams. The Russian River from Ukiah down to its mouth is rated as a premium (Class I) scenic, fishery, wildlife, and recreational waterway. Tomales Bay is rated as a Class II scenic waterway; both under the California Protected Waterways Plan (See Section A-3e). Coastal scenery is also being proposed for preservation all along the entire length of SR 1, the Coast Highway, since it is being proposed for inclusion in the State Scenic Highway System (see Section A-3f). Also there is a proposal to extend SR 37 west of Novato to Marshall along Novato Blvd. (the old Hicks Valley Road) Wilson Hill Road, and Marshall-Petaluma Road and make it a state scenic highway. This roadway cuts right across Sub-Area 18.6. (Refs. 30, 67, 92.)

There are a number of scenic wooded areas within Site 18 that have not received official designation and which also demand recognition. The first are the Redwood stands in the Camp Meeker Area (south-central 18.9 north). The other major one consists of the virgin redwood groves being proposed for inclusion in a San Geronimo Redwoods County Park to be located south of the Nicasio Reservoir (in Sub-Area 18.3). Redwood forests

are a dwindling scenic resource unique to the Pacific Coast.

These scenic values are somewhat marred by the near universal appearance of roadside refuse scattered all along the edges of the Site's many roads and concentrated particularly at natural and specifically provided stopping and pull-off viewing areas.

Some idea of the scenic values of Site 18 can be anticipated in some of the views presented in Figures V-D-5a, 5b, 5c, and 5d.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact of wastewater land application would be the loss of vegetation, wildlife habitat, and wildlife on spoil areas.

Discussion and Remedial, Protective, and Mitigation Measures: Refer to discussion of Impact 13 for Site 4.

b. Impact 2

The second impact would be the loss of wildlife species through loss of habitat (lands, vegetation) to project facilities.

Discussion and Remedial, Protective, and Mitigation Measures: Refer to the discussion of Impact 5 for Site 4.

c. Impact 3

The third impact would be the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion and Remedial, Protective, and Mitigation Measures: Refer to the discussion of Impact 12 for Site 4.

d. Impact 4

The fourth impact would be the change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion and Remedial, Protective, and Mitigation Measures: Refer to the discussion of Impact 12 for Site 5.

e. Impact 5

The fifth impact would be the change in the micro-climate caused by the increased available moisture.

Discussion and Remedial, Protective, and Mitigation Measures: Refer to the discussion of Impact 14 for Site 5.

f. Impact 6

The sixth impact would be the reduction in the water quality of the lower Russian River because of high total dissolved solids (TDS).

Discussion: Surface and subsurface drainage of wastewater into the Russian River may considerably increase the TDS concentration. The TDS ranges from 130 to 175 ppm in the Russian River below Guerneville. The recovered wastewater will be considerably higher in TDS than presently found in the Russian River.

	Surface Drainage	Subsurface or Groundwater
TDS (mg/l)	400-1,000	800-2,000

The estimated quality of the wastewater in TDS does not meet the water quality objectives of the California Regional Water Quality Control Board for the North Coast Region. They recommend a maximum of 200 mg/l and a median of 170 mg/l for TDS in the Russian River downstream of its confluence with the Laguna de Santa Rosa. Depending upon the amount of recovered wastewater entering the Russian River by surface or subsurface drainage, it could increase the existing TDS level above the objectives of the North Coast board.

TDS over 1,000 mg/l is suspected of reducing reproductive capacities of some fish species such as Centrarchids and Cyprinids (sunfish and carp).

Remedial, Protective and Mitigation Measures: Monitoring of all outflows will be necessary to control the water quality of the effluent. Pre- or post-application treatment will be necessary to prevent degradation of surface water.

g. Impact 7

The seventh impact would be possible accelerated eutrophication of the lower Russian River because of an increased biostimulant load.

Discussion: The increase in biostimulants, total nitrogen (TN), and total phosphorous (TP), would increase the possibility of algal "blooms" in the lower Russian River. "Phytoplankton growths are approaching nuisance levels in many sections of the lower Russian River", especially below Mark West Creek (Ref. 40) TN and TP values are not given for this area (see D-17).

Surface and subsurface drainage of wastewater will contain significant amounts of TN and TP

	Surface Drainage	Subsurface or Groundwater
TN (mg/l)	6-20	3-20
TP (mg/l)	2-4	1-2

The California Regional Water Quality Control Board for the North Coast Region has not set objectives for TN and TP, but total nitrogen levels higher than 1 mg/l and total phosphorous levels above 0.1 mg/l generally encourage noticeable growths of algae.

Large algal "blooms" may cause serious problems to fish. Oxygen used during decomposition of the algae may deplete the available oxygen and cause fish kills.

Remedial, Protective and Mitigation Measures: Pre- or post-application treatment of recovered wastewater to prevent the degradation of ground or surface water.

h. Impact 8

The eighth impact would be the possible increase in temperature of surface waters and a change in species composition of water associated species. (See water temperature D-16.)

Discussion: Application of wastewater either directly or indirectly to stream channels may increase the temperatures of existing flows.

If the temperature of the recovered wastewater is considerably higher than that of surface waters, there may be a change in the species composition in the stream. Salmonids (salmon and trout) will be displaced to cooler areas (if cooler areas are available) and the vacancies will be occupied by warmwater fish such as sunfish, suckers, and squawfish. There would also be a loss of the cool water invertebrates which serve as fish food.

Water temperature is especially critical in small coastal streams where the late summer flows are low and water temperatures are high. Optimum temperatures for salmonid fish species are:

Resident trout

Winter - 42-58°F
Summer - 45-68°F

Migration routes (anadromous salmonids)

45-68°F

Spawning areas (resident and anadromous salmonids)

45-55°F

Rearing areas (resident and anadromous salmonids)

50-68°F

Refer to Impact 9 of Site 28 (Section H-6i) for additional discussion of this subject.

Remedial, Protective and Mitigation Measures: Control temperature of the stream by preventing wastewater from entering the stream if temperatures are above those critical to salmonid fishes. Temperatures below 68°F during the summer, 58°F during the winter, and 55°F during spawning season would be acceptable.

Prevent the drainage of large amounts of recovered wastewater, that have been exposed to the sun for long periods of time, into streams. Warm recovered wastewater could increase water temperature.

Provide watershed protective "buffer" strips alongside streams where treated wastewater is not applied. (This would not prevent subsurface drainage into streams.)

Refer to Site 28, Impact 9 for additional remedial, protective and mitigation measures (Section H-6i).

i. Impact 9

The ninth impact would be the accelerated eutrophication of small streams in Site 18 because of increased biostimulants from recovered wastewater and increased use of pasture areas. This impact is necessary because the Russian River has a eutrophication problem which has sources not related to these.

Discussion: There are many small coastal streams within Site 18. Laguintas Creek, San Geronimo Creek, Walker Creek, Dutch Bill Creek, and Salmon Creek are several of the larger drainages of the area. Subsurface or surface drainage of wastewater into these creeks could add enough biostimulants to cause serious algal "blooms". Dairy pollution is currently a problem on Lagunitas Creek. For example, in one location a large dairy cattle "feedlot" was located immediately adjacent to the stream. Dairy pollution adds large amounts of urea and ammonia to surface and subsurface waters. Both ammonia and urea are toxic to fish. Urea is ultimately biodegraded to other nitrogen forms.

The estimated quality of recovered wastewater could add additional amounts of nitrogen and phosphorous to surface waters. Total phosphorous (TP) content of surface drainage recovered water will be approximately 2-4 ppm, subsurface drainage approximately 1-2 ppm. Total nitrogen levels will vary from 6 to 20 ppm for surface drainage and from 3 to 20 ppm for subsurface drainage of forest and pasture areas and 21 to 70 ppm for rapid infiltration areas.

Small increases in total nitrogen (<1 mg/l) and total phosphorous (<0.1 mg/l) could aid productivity in some of these streams, but excessive amounts would produce nuisance algae problems.

Remedial, Protective and Mitigation Measures: Pre- or post-treatment of recovered wastewater to prevent the degradation of ground or surface water.

j. Impact 10

The tenth impact would be the possible increased erosion problem because of additional water.

Discussion: There is the possibility of increasing the erosion hazard on grass, pasture, and forest land in Site 18. Serious erosion problems could develop when the ground is saturated with wastewater and a rainstorm occurs. The soil would not be capable of absorbing additional water and heavy runoff could be anticipated if the rainstorm was heavy.

Loss of vegetation and wildlife habitat would be the result of erosion. Excessive siltation of streams would destroy salmon and steelhead spawning areas and destroy aquatic invertebrates which form the basis of aquatic food chains.

Remedial, Protective and Mitigation Measures: Apply wastewater during the times of the year when heavy rains would not be probable.

Apply wastewater at a low rate so that the ground would not be saturated at any one time (winter and spring).

k. Impact 11

The eleventh impact would be the pollution of Nicasio Reservoir by surface and subsurface drainage of wastewater.

Discussion: Nicasio Reservoir is an alternate public water supply for Marin County. It also contains a sport fishery. Surface and subsurface drainage of wastewater into Nicasio Reservoir could pollute and contaminate the reservoir and present a potential public health hazard. Recovered wastewater should meet the water quality objectives for public water supplies (contained in Table II-G-6 of the Volume II report) if it infiltrates into a public water supply.

The sport fishery could be impacted depending upon the concentration of TDS, TN, and TP in the recovered wastewaters. Excessive eutrophication of the reservoir would lower its aesthetic and fishery values.

Remedial, Protective and Mitigation Measures: Exclusion of Nicasio Reservoir and its drainage area (Halleck Creek, Arroyo Nicasio, and Redwood Canyon) as a possible wastewater application area.

l. Impact 12

The twelfth impact would be the establishment of permanent waterflows in heretofore intermittent streams.

Discussion: There are many intermittent streams in Site 18. These could be developed into permanent flows by surface and subsurface drainage of wastewater from crop and pasture areas. Fish would immigrate into these waters from permanent streams if the quality of the wastewater was high. Additional water would be beneficial to some area wildlife, although it would create more habitat for the intermediate host species (some snail species) or vectors of certain deer parasites and diseases.

Remedial, Protective and Mitigation Measures: This would be a beneficial impact if fisheries were established in the perennial stream flows. Consideration must be given to the possible increase of intermediate hosts or vectors of wildlife parasites and diseases.

m. Impact 13

The thirteenth impact would be the augmentation of stream flows during summer months.

Discussion: Low flows are common in many coastal streams of Site 18 during the summer months. Surface drainage of wastewater could be used to augment the flows of streams. Water quality would have to be high and erosion negligible, especially in streams where young and adult salmonids are present. Temperature and dissolved oxygen should remain within the optimum level for salmonids at all times. (See discussion of Impacts 7 and 9 for Site 28, Chapter H, sections 6g and 6i.)

This would be a beneficial impact.

n. Impact 14

The fourteenth impact would be the effect of constant moisture or humidity on wildlife.

Discussion: The application of large quantities of wastewater by sprinklers or misting may have an undesirable effect on wildlife. These may be as yet undiscovered factors that would disrupt or alter the life cycle of wildlife. The constant fog produced by misting and the high humidities may be disturbing to reptiles, birds and mammals.

Remedial, Protection and Mitigation Measures: There should be "escape zones" where animals could frequent if the constant moisture disrupted facets of the animals' life cycle or proved annoying to the animal. These zones would be free of any wastewater distribution system and their frequency of distribution would allow both mobile and relatively sedentary animal species to utilize them.

o. Impact 15

The fifteenth impact would be the possible increase in wildlife diseases because of wastewater application.

Discussion: The impacts and diseases would be the same as those discussed for Site 21. Refer to the wildlife disease section of the present environment report for a complete description of important wildlife diseases found in Site 18 (Section D-3b).

p. Impact 16

The sixteenth impact would be possible changes in the ecology of Tomales Bay because of the addition of wastewater by surface and subsurface drainage.

Discussion: The environmental state of Tomales Bay is quite good. Development of the bay is still minimal, there is no industrial waste entering the bay, and domestic waste enters in small amounts. There is some dairy waste runoff into Tomales Bay from creeks and drainage areas around the bay. This accounts for high coliform bacteria counts during much of the year (Ref. 122)

The addition of wastewater into Tomales Bay via subsurface drainage and surface drainage (especially streams, Walker Creek) may alter the present environment of Tomales Bay.

The additional nutrients (nitrogen and phosphorous) could cause algal "blooms". Noxious algae production could increase, which would be detrimental to fish, other aquatic life and recreation.

Algae beds have been seriously damaged by sewage outfalls in southern California. Large amounts of industrial and domestic sewage tend to suppress kelp growth and permit large populations of sea urchins, which graze on the kelp, to develop. The loss of kelp beds would displace the fish that utilize these beds for cover. Recognizing past events, questions arise as to the effects of this project on the inshore marine environment.

Remedial, Protective and Mitigation Measures: Exclude Tomales Bay and its entire drainage system (especially Walker Creek) from wastewater application area.

Pre- or post-application treatment of wastewater to prevent degradation of surface or subsurface water drainage into Tomales Bay.

q. Impact 17

The seventeenth impact would be TDS buildup in soils that receive treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 7 for Site 5 (Section C-6g).

r. Impact 18

The eighteenth impact would be the possible increase in heavy metal concentrations because of wastewater application.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 4 for Site 4 (Section B-6d).

s. Impact 19

The nineteenth impact would be the possible change in the gross recreation potential of Site 18 if wastewater applications are made.

Discussion: Site 18 is heavily used by recreationists. The gross recreational potential to Site 18 was estimated to be 254 million visitor-days per year. The Russian River, Bodega and Tomales Bays (immediately adjacent to Site 18) and the Point Reyes Peninsula are heavily used areas.

Algal "blooms" are unsightly and, depending upon the species of algae, may be noxious to fish and other aquatic species. This would affect the recreation potential for the Russian River, Tomales Bay and Bodega Bay since all areas support swimming, boating and fishing.

Many "second homes" are located on the coast from Tomales Bay north to the Russian River. The application of wastewater on or near these areas would be very displeasing (if their contents are known) to residents.

Many persons drive through Site 18 on Highway 1 (proposed scenic highway) and the many surface roads found in the coastal mountains. Above-ground distribution systems may be aesthetically displeasing to residents and visitors using Site 18.

Remedial, Protective and Mitigation Measures: Use native vegetation whenever possible to screen project facilities and above-ground distribution facilities.

Exclude all public and private recreational facilities, private homes, and "scenic highways" from wastewater disposal.

Provide a buffer strip between wastewater application areas and public roads and public and private facilities.

t. Impact 20

The twentieth impact would be the generation of unpleasant odors.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 21 for Site 5 (Section C-6u).

u. Impact 21

The twenty-first impact would be the possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 15 for Site 4 (Section B-6o).

v. Impact 22

The twenty-second impact would be the introduction of fish diseases and parasites into new areas by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 4 (Section B-6p).

w. Impact 23

The twenty-third impact would be the increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 17 for Site 4 (Section B-6q).

x. Impact 24

The twenty-fourth impact would be an increase in stress factors of fish and their relationship to the susceptibility of fish to disease and parasitism.

Discussion: Site 18 has numerous waterways that support anadromous fish (Russian River and small coastal streams). Some of these streams already have pollution problems (Russian River and Lagunitas Creek) and the addition of wastewater to these waterways may compound the problems. The addition of biostimulants to these waterways may cause nuisance algae growth which could cause oxygen depletions and stress on the fish (especially young anadromous fish).

Wastewater holding reservoir(s) built in this area should be constructed to prevent the isolation of localized pockets of water during the summer. This could crowd fish into localized pockets, decrease the general health of the fish and increase their susceptibility to disease and parasites.

Remedial, Protective and Mitigation Measures: Pre- or post-treatment of the water to prevent the degradation of existing water quality through the surface or subsurface drainage of wastewater.

y. Impact 25

The twenty-fifth impact would be the increase in fish diseases because of higher water temperatures of recovered wastewater and increased bacterial growth.

Discussion: The small coastal streams of Site 18 are critical habitats for anadromous fish species. Any alteration of the stream that would encourage the increased growth of bacterial fish diseases would be detrimental to these fish. Recovered wastewater draining into these streams, especially after long exposure to the sun on irrigated crops or pasturage, may considerably increase the water temperature of the streams. This could increase bacterial growth, and become especially critical in the summer when stream flows are low and fish are concentrated (especially young salmonids) in the cooler, deeper pools.

Remedial, Protective and Mitigation Measures: Control temperature of the recovered wastewater to a level that would not significantly increase the temperature of existing waterways.

z. Impact 26

The twenty-sixth impact would be the possible disruption in the life cycle of anadromous salmonid fishes because of a change in water quality due to the addition of treated wastewater.

Discussion: Salmon are thought to locate their home stream by chemical reception and not by physical parameters of the stream channel. The addition of cations (Ca^{++}, Mg^{++}, etc.) and anions (Cl^-, $SO_4^=$, etc.) may affect the as yet undetermined chemical stimulus(i) that trigger(s) migrating adult salmon to return to their home stream. Adult salmon that are not able to return to their home stream may not enter any other stream to spawn. If this were to occur, it would cause a serious reduction in the coho and chinook salmon population of California.

Remedial, Protective and Mitigation Measures: Conduct further investigations into the area of home stream selection by salmon.

Pre- or post-application treatment of wastewater to prevent degradation of the quality of surface and subsurface water.

aa. Summary of Sensitive Areas

Figure V-D-1 delineates the location of environmentally "sensitive" areas within Site 18. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

The "sensitive" areas of Site 18 consist of: (1) the Russian River and a recreational area band along its south bank along the northern perimeter of Sub-Site 18.1 and 18.4, (2) Green Valley Creek in Sub-Site 18.1, (3) Dutch Bill and Willow Creek in Sub-Site 18.4, (4) Salmon Creek and its major tributary streams in Sub-Site 18.2, (5) Estero Americano and Americano Creek and its major tributary streams in Sub-Site 18.5, (6) Walker Creek in Sub-

Site 18.6 and its major tributaries, principally Chileno Creek and Laguna Reservoir, Arroyo Sausal, and Salmon Creek, (7) Lagunitas Creek, along the western perimeter of Sub-Site 18.3, and its major tributaries, Nicasio Creek and Reservoir, and Halleck Creek, all in Sub-Site 18.3, (8) the coastline, along almost all of the western perimeter of Site 18, (9) the scenic highway, SR 1, along most of the coastline and western perimeter of the Site and through Sub-Sites 18.5 and 18.6 and 18.3, (10) coniferous Redwood forest areas in the eastern half of Sub-Site 18.3, the northern part of 18.1, and the north-central part of 18.2, also in the vicinity of Samuel P. Taylor State Park in southwestern Sub-Site 18.3 and another area in the southeastern part of 18.3, and (11) a recreational area in a much larger southwestern sector of Sub-Site 18.3 including Samuel P. Taylor State Park and environs.

SECTION E

E. WASTEWATER LAND APPLICATION SITE 21: NORTHEASTERN SONOMA COUNTY - HEALDSBURG AREA

1 - Project Development

a. Present Land Uses

Site 21 is located in east northeastern Sonoma County partially astride the Russian River, just north of the Santa Rosa-Cotati Valley, and just 2 miles southeast of Cloverdale. Santa Rosa is located about 5 miles south of the Site's southern limits; Calistoga in the northern end of the Napa Valley just under 3 miles east of its southeast corner; Middleton in Lake County about 4 miles northeast of its northeast corner; Healdsburg right along the Site's western limits; and Geyserville being just inside the northwestern limits. The eastern perimeter is provided by the ridge line of the Maacama Mountains which also provides the boundary line between Sonoma and Lake and Napa Counties, Mt. St. Helena being just about at the point where the Lake-Napa County line takes off to the east. The northern perimeter is provided almost entirely by the southern watershed limits of the Big Sulphur Creek watershed which constitutes a wavy line from Pine Mountain in the Maacama range westward to Black Mountain and on almost to Cloverdale. The western perimeter, from north to south, is provided by (1) the Russian River's east bank levee south to the mouth of Barrelli Creek (on the west bank) just north of Asti, (2) Barrelli Creek southwest to its headwaters divide, (3) the low hill ridge line separating the Dry Creek drainage to the west from Site 21's Alexander Valley southeast across US 101 and on to the Russian River's Digger Bend (just northwest of Fitch Mt.,) and (4) the east bank of the Russian River south to a point just about due west of the Sonoma County Airport. The southern perimeter, from west to east, is provided by (1) a wavy east-west line proceeding eastward to, along, and then just beyond the northern boundary of the Sonoma County Airport, (2) Airport Blvd. east to the Old Redwood Highway, (3) the Old Redwood Highway southeast to Mark West Creek, (4) Mark West Creek east for about a mile, (5) a ridge line along the easterly watershed limits of upper Windsor Creek northerly, and (6) a ridge line separating a section of the Mark West Creek drainage from the Franz Creek drainage point just north of Mark West Springs easterly to the Sonoma-Napa County line. Use Figures V-E-1 and 2 and V-A-7 for location reference.

Site 21 occupies about 125,000 acres. For study purposes, it has been divided into three sub-areas as shown in Figures V-E-1 and 2. These sub-areas and their areas are as follows:

(From Vol. II Figure II-F-1, Pg

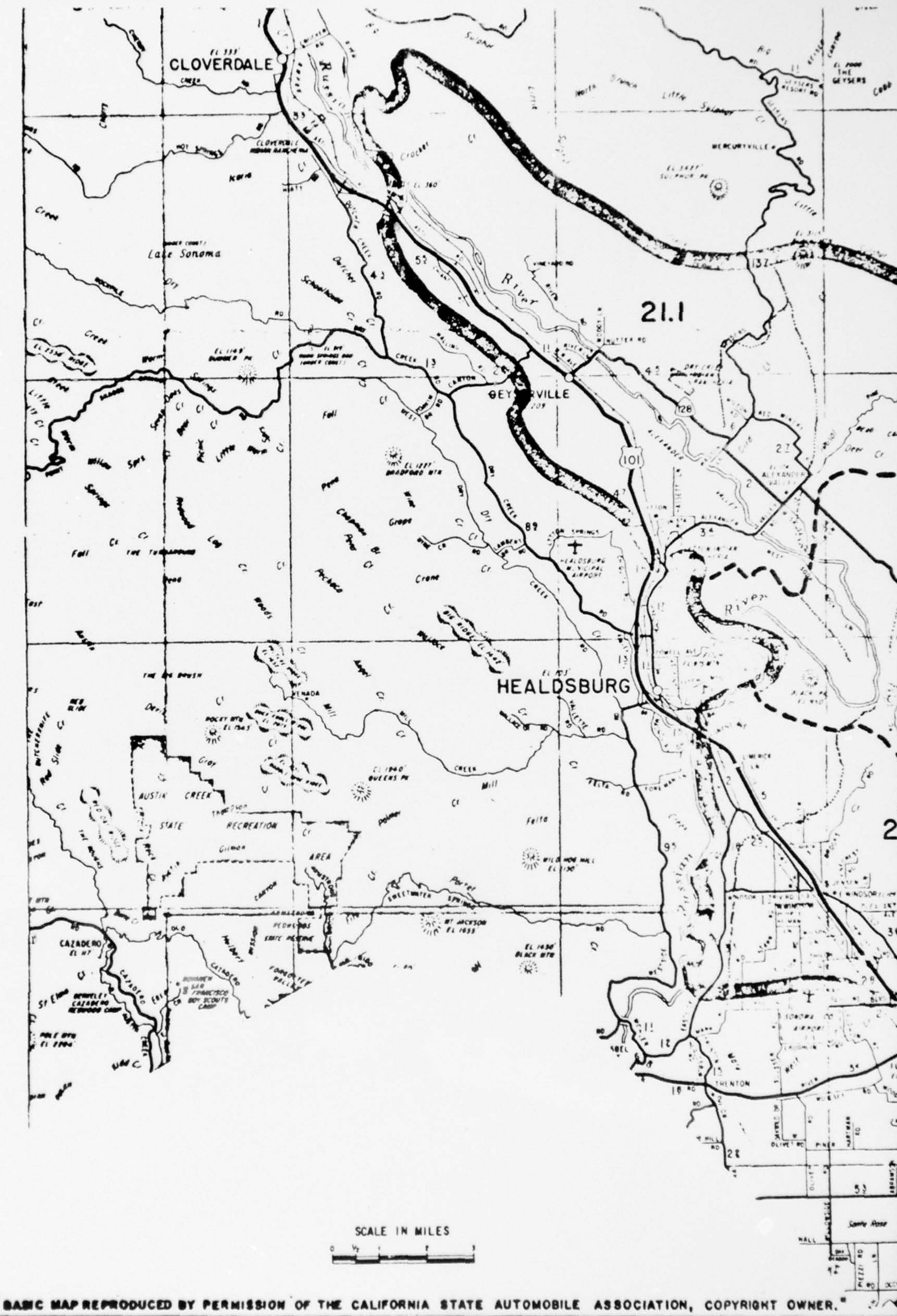
1

2

Figure V-E-1

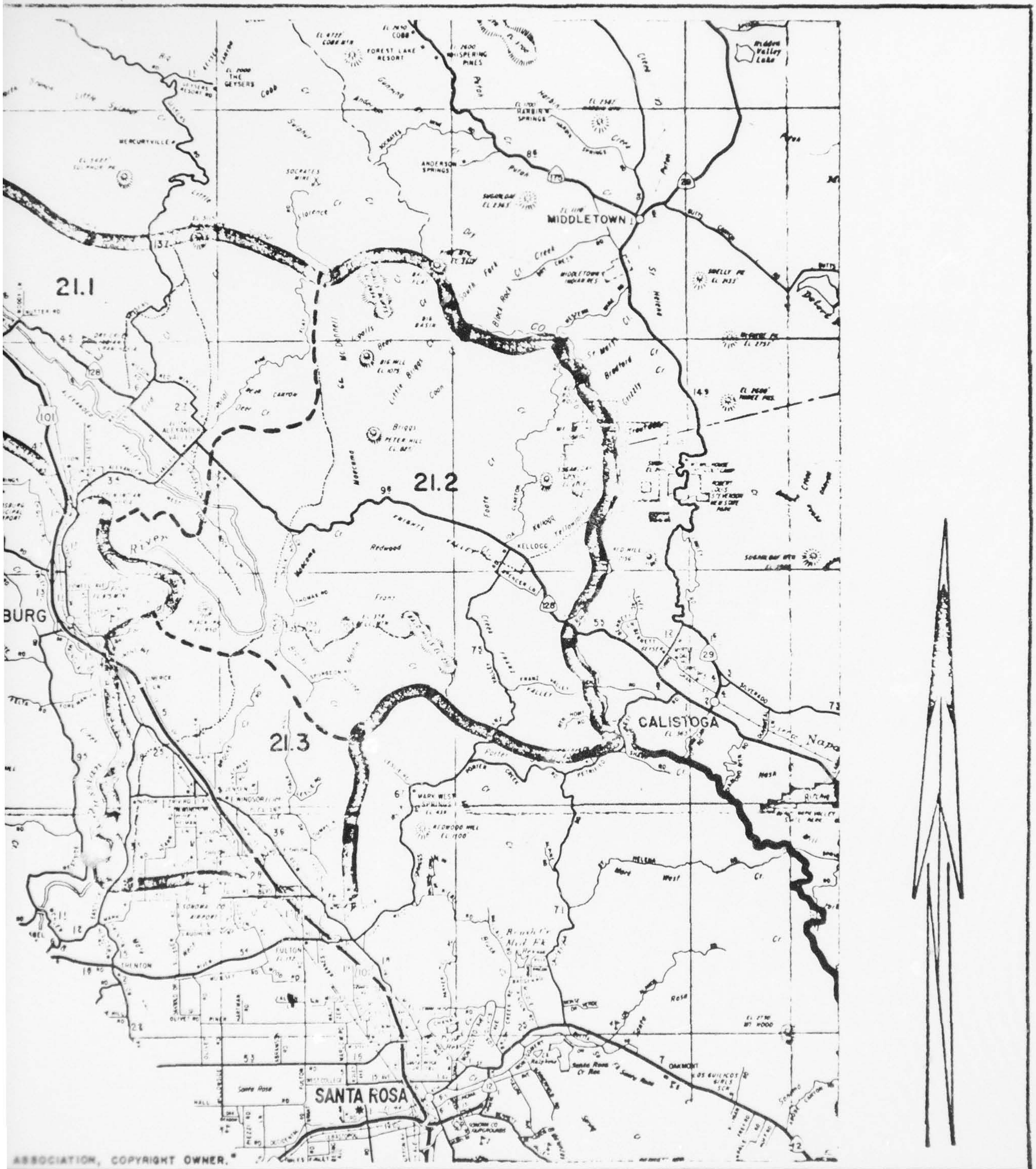
PBQ&D, Inc.

(From Vol. II, Figure II-E-1, Pg. E-11)



"BASIC MAP REPRODUCED BY PERMISSION OF THE CALIFORNIA STATE AUTOMOBILE ASSOCIATION, COPYRIGHT OWNER."

Figure V-E-2


21.1
21.2
21.3
MIDDLETOWN
CALISTOGA
SANTA ROSA
BURG
THE GEYSERS
COBB
FOREST LAKE RESORT
WHISPERING PINES
HARBIN SPRINGS
ANDERSON SPRINGS
MERCURYVILLE
Middle Valley Lake
ASSOCIATION, COPYRIGHT OWNER."

Sub-Area No.	Sub-Area Designation	Area in Acres
21.1	Alexander Valley	42,600
21.2	Knight's Valley	60,400
21.3	Windsor	22,000

Agriculture is the predominant land-use in the lower elevations. Grass meadows and hardwood and coniferous forests occupy the higher elevations. The Russian River furnishes the main source for irrigation water for the Site's many orchards and vineyards. Some areas pump directly from the river and others from wells drawing on the river. The river is supported in the dry season by releases from Coyote Dam in the vicinity of Ukiah. The Corps of Engineers is currently constructing a dam on Dry Creek for the purpose of controlling flows downstream and using the releases in summertime to maintain adequate flows in the river and to provide for the water supply for the Sonoma-North Marin area through the use of Ranney wells in the river bottom. The Site has a moderately extensive system of roads and it is dotted, here and there, with many small towns and communities. Recreational and associated land-uses are also improtant. The Russian River, a year-around flowing stream, has been designated as a Class I premium scenic, fishery, wildlife, and recreational waterway under the California Waterways Plan.

Relative to future development, the Corps of Engineers has an authorized project to construct a dam in the Knights Valley area for the purpose of regulating Franz and Maacama Creeks. This proposed reservoir would inundate a major protion of the eastern part of Sub-Area 21.2 and, at a water elevation of 600 feet, would effectively flood out all of the Franz and Knights valley bottoms.

b. Development Objectives

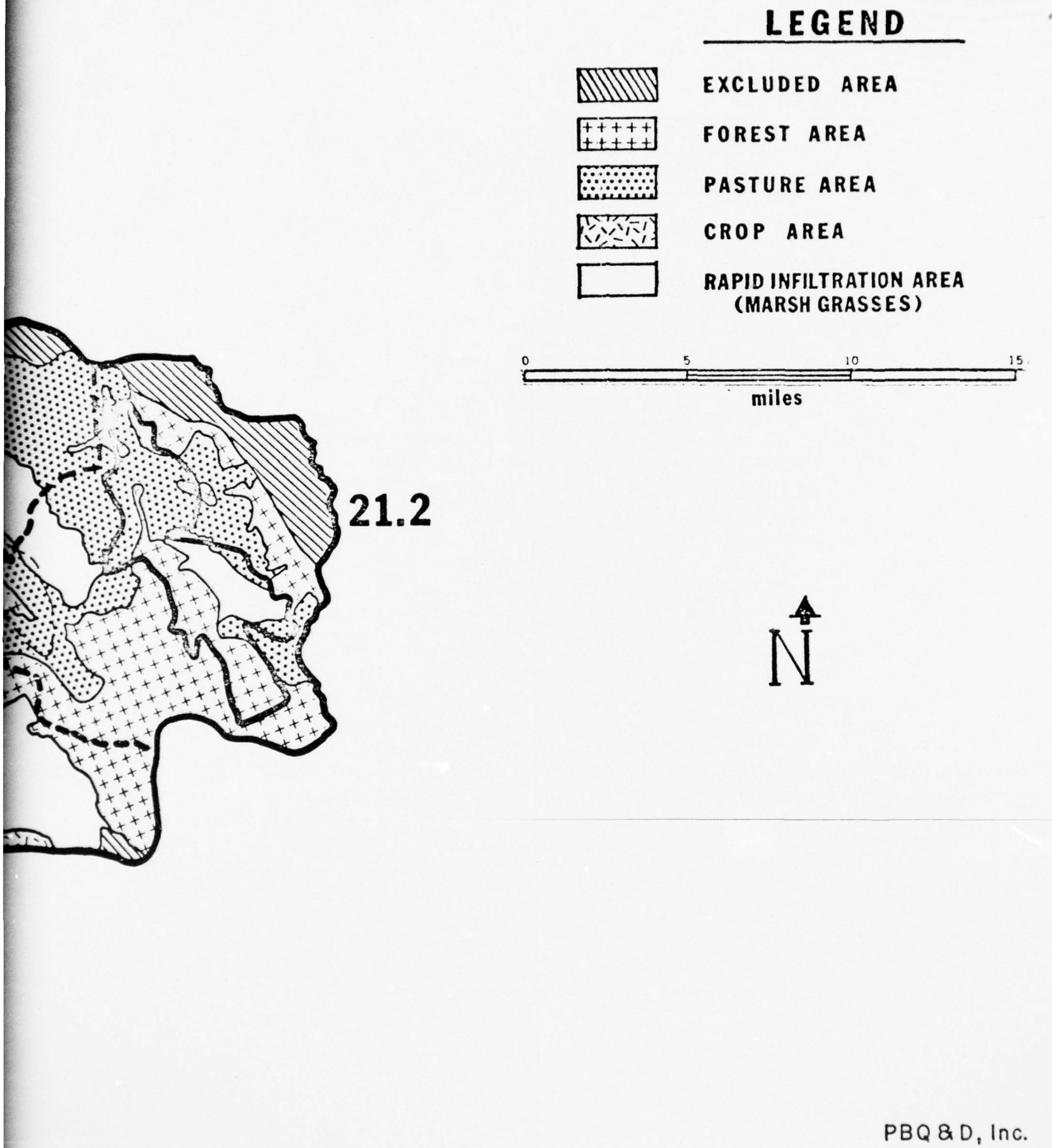
The valley areas of Site 21 are considered representative of a number of interior valleys of the Coast Range. They offer potential for the irrigation of existing crops and for new irrigation of forest areas. Related to this is the possibility for stream flow augmentation of the Russian River south of Healdsburg, particularly for recreational use during the summer season. Another potential is that of augmentation of groundwater supplies which are currently being pumped from the area into the domestic supply systems of communities located to the south of the Site Area.

Proposed land uses and types of land application based on soil capabilities are shown in Figure V-E-3. This figure and Figure V-E-4 also show areas which will almost certainly be excluded because of excessive elevation (over 1500 feet.) Areas with slopes over 30 percent predominating

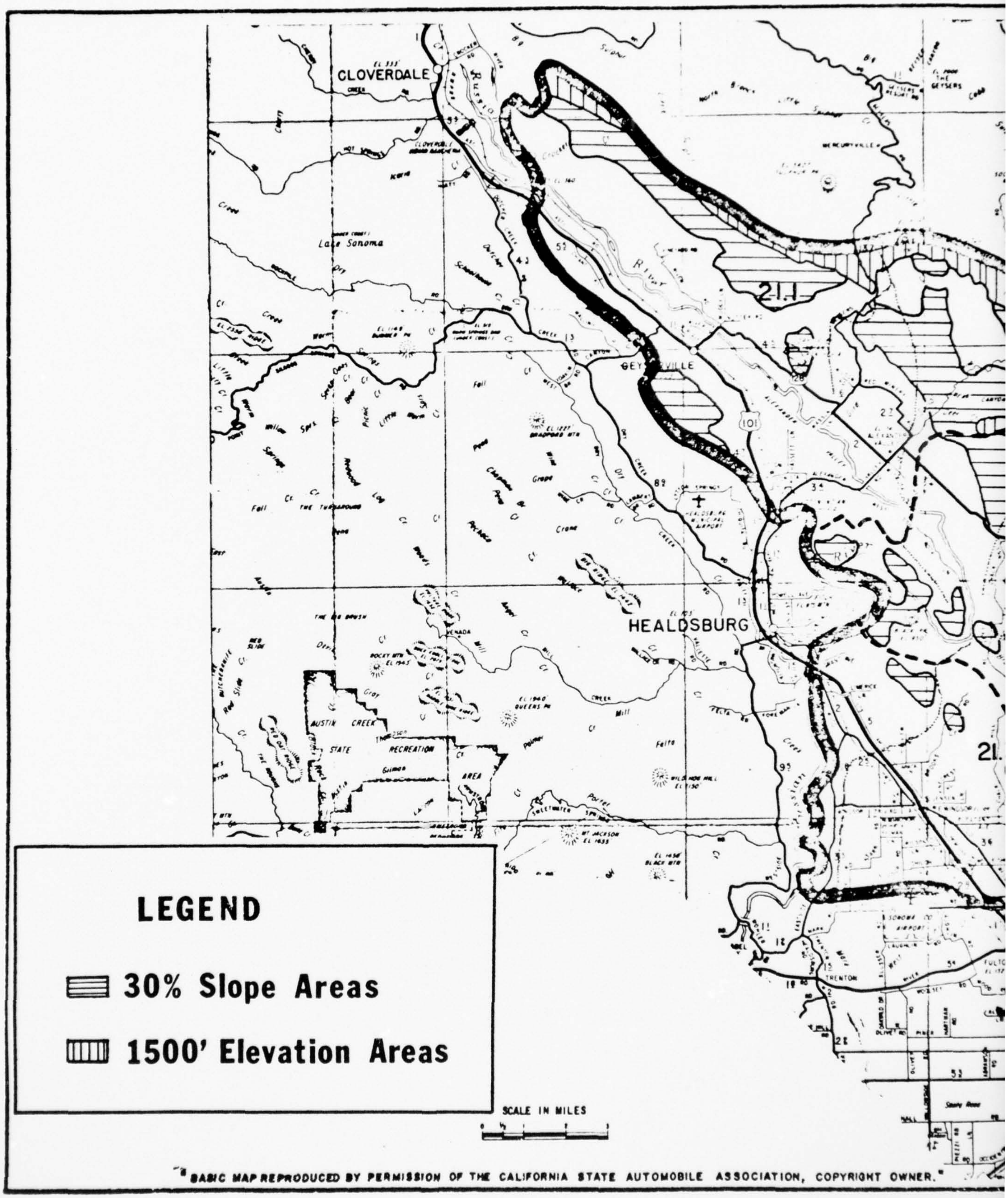
PROPOSED AND POTENTIAL LAND USES FOR WASTEWATER LAND APPLICAT

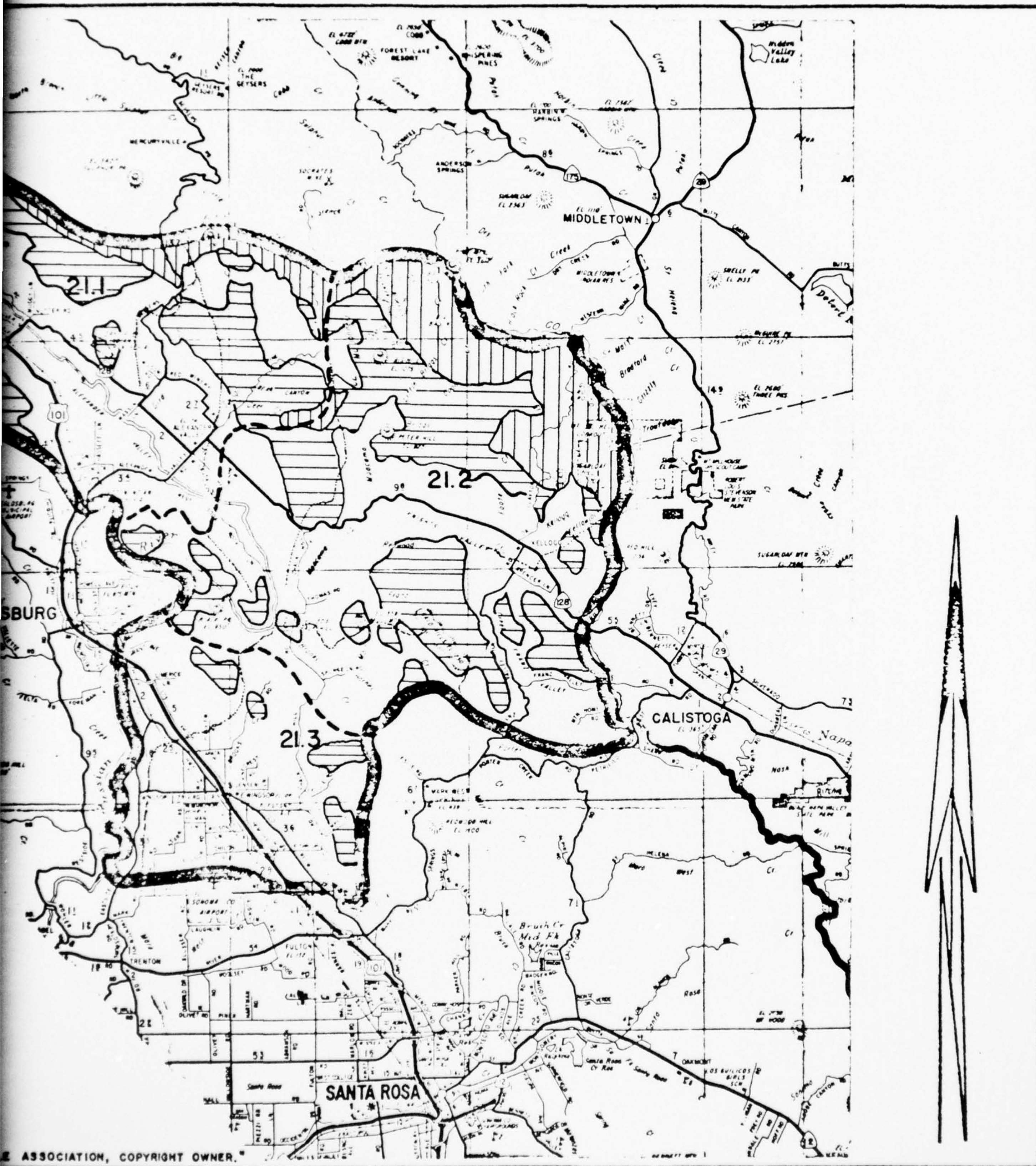
(From Vol. II, Figure II-E-2, Pg. E

WASTEWATER LAND APPLICATIONS



rom Vol. II, Figure II-E-2, Pg. E-21)


CLOVERDALE
Lake Sonoma
GEYSERVILLE
HEALDSBURG
AUSTIN CREEK STATE RECREATION AREA
TRENTON
21.1
LEGEND
30% Slope Areas
1500' Elevation Areas
SCALE IN MILES
"BASIC MAP REPRODUCED BY PERMISSION OF THE CALIFORNIA STATE AUTOMOBILE ASSOCIATION, COPYRIGHT OWNER."


MIDDLETOWN
CALISTOGA
SANTA ROSA
21.1
21.2
21.3
SBURG
ANDERSON SPRINGS
FOREST LAKE RESORT
THE GEYSERS
MERCURYVILLE
FULTON
TRENTON
SONOMA CO AIRPORT
101
128
29
175
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have been delineated in Figure V-E-4. These latter areas are strong candidates for exclusion because of erosion enhancement and possible landslide conditions. These areas have been delineated as a result of on-site inspections and subsequent topographic map analysis. Recommended unit application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10.

The possible sources of wastewater for land application to parcels in Site 21 and the possible specific combinations of them will depend upon the degree and extensiveness of the regionalization in the collection and treatment of wastewaters thought advisable. The possible sources include Cloverdale to the northwest; Healdsburg to the immediate west; from communities within the Site Area such as Windsor and Geyserville; from Calistoga, St. Helena, and Yountville and other small communities of the upper Napa Valley to the southeast, perhaps also Napa and other communities of the lower Napa Valley; from the Mark West Springs to the immediate southeast; from Santa Rosa and perhaps Sebastopol to the south. These treated wastewaters can be brought into the Site Area along a number of major and a few minor roadways from the various possible source areas. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible sources of wastewater indicated above.

The distribution and recovery systems will follow the management and development outlines presented in Section A- 7a, b, and c. The estimated quality of recoverable wastewaters is that presented in Table V-A-7. The general conveyance of wastewaters into Site 21 is uphill and it is therefore expected that the distribution system will be designed much like that of many water supply distribution systems complete with pressure zones to minimize pumping costs. The general slope from Cloverdale is downhill, with the lowest entrance elevation being about 250 feet along the Russian River, the roadway entrance elevations being about 30 to 50 feet higher. The general slope from the south is uphill, with the lowest entrance elevations being about 70 feet along Windsor Creek, about 60 feet along the Russian River, and about 157 to 159 feet along Eastside Road and the Old Redwood Highway. Healdsburg is at about 100 feet elevation. Access to Sub-Areas 21.2 and 21.3 require going under the Russian River. Access to Sub-Area 21.1 to the north encounters the lowest entrance elevation (about 200 feet) along the Old Redwood Highway and US 101. The lowest access or entrance elevations from the general direction of Calistoga are 706 feet along SR 128 (into the upper end of Knights Valley, Sub-Area 21.2, 978 feet along Franz Valley School Road (into upper end of Franz Valley,) and approximately 980 feet at a "pass" in the ridge line east of the Chalk Mountains and west of Mt. Home Ranch Road. The lowest access or

elevations from the Mark West Springs area is 1055 feet along Franz Valley Road (into lower end of Franz Valley) and about 480 feet at a "pass" in the ridge line to the southwest (into Sub-Area 21.3.) From this brief analysis, one can gather some conception of what areas in general could be served by gravity lines once the wastewater had been conveyed into the Site at various points. The flatlands of the Windsor area (Sub-Area 21.3) lie below the 200 foot elevation; those of Franz Valley between 540 and 600 feet; those of Knights Valley between 380 and 520 feet; and those of Sub-Area 21.1 below the 220 foot elevation generally.

The location of conveyance and pumping facilities in the more mountainous portions of Site 21 will require substantial analysis of flow and pumping requirements in relation to existing topography. In the areas of less pronounced relief, conveyance and pumping facilities could be located in alignments unrestricted by topography. It is expected that distribution will be along the major roadways with laterals branching off at selected elevations at the higher entrance points to some valley areas (such as Franz and Knights Valleys) and following these elevation lines around the valley perimeter for purposes of gravity distribution. Significant areas for land application exist in all sub-areas of Site 21. However the proposed rapid infiltration areas are largely confined to Sub-Areas 21.1 and 21.3.

Site 21, like Site 18, lies wholly within the Coast Range geomorphic province, and specifically within the inner or interior portions of the range. Its two characteristic and generalized physiographic regions are (1) fairly small rugged and low open mountainous uplands which generally rise to elevations between 1000 and 3000 feet along most ridge lines, and (2) the intermountain valley lowlands which are generally youthful and V-shaped. Elevations in Site 21 range from a low of about 60 feet along the Russian River at the south end of Sub-Area 21.3 to a high of 4343 feet at Mt. St. Helena on the eastern perimeter of Sub-Area 21.2. The southern half of Sub-Area 21.2 and all of Sub-Area 21.3 is generally 20 to 50 percent gently sloping with over 75 percent of the gentle slopes being in the lowlands, a characteristic of most of the Coast Range from this area south to Santa Barbara County. The northern half of Sub-Area 21.2 and all of Sub-Area 21.1 (except for the Alexander Valley lowlands) is generally less than 20 percent gently sloping, a characteristic of the entire western half of the Sierra Nevada mountain range.

Most of the lowlands of Site 21 are in somewhat more mature, more U-shaped valleys, specifically the Alexander Valley of Sub-Area 21.1 (the valley of the Russian River floodplain just above Healdsburg,) the valley of the Russian River floodplain and Windsor Creek drainage in the Windsor area of Sub-Area 21.3 (just south of Healdsburg,) and Knights Valley of Sub-Area 21.2 (the floodplain of the lower reaches of Redwood Creek.) The Alexander Valley ranges in width from 0.8 to 3.6 miles inside Sub-Area 21.1; Knights Valley from 0.8 to 1.8 miles; and the Windsor area floodplain from 2 to 5.4 miles. The Windsor area floodplain valley is really a northerly extension of the Santa Rosa-Cotati-Petaluma Valley with Dry Creek's valley (lying west of Sub-Areas 21.1 and 21.2) being a further northerly extension; the entire valley "chain" being part of one intermountain fold which is a major northerly extension of the great San Francisco Bay depression, with the Petaluma Valley portion being in the San Francisco Bay drainage and everything north being in the Russian River drainage. The Alexander Valley is separated from the Windsor area Russian River valley by a band of low mountains (Fitch Mt., Black Peak, Chalk Hill, Bell Mt., Bald Hills) ranging in elevation between 305 and 1250 feet through which an "S" meander of the Russian River passes. This band of mountains extends northwesterly to provide the southwestern ridge line of the Alexander Valley (and the divide between it and the Dry Creek drainage) and southeasterly along the eastern perimeter of Sub-Area 21.3 and onward to the Sonoma Mountains to the east of the Santa Rosa-Cotati-Petaluma Valley.

Figures V-E-5a and 5b show some typical views of the Site.

Site 21

1. El Carmelo Catholic Chapel from Old Redwood Highway (Asti Road) at N End of Asti

2. NE Across Russian River toward NE B
Note Old Cars Used for Backline Implaceme

4. N Along E Bank of Russian River Flood Plain with Fitch Mountain in Center just Below Horizon from Access Road of Kaiser Sand Works

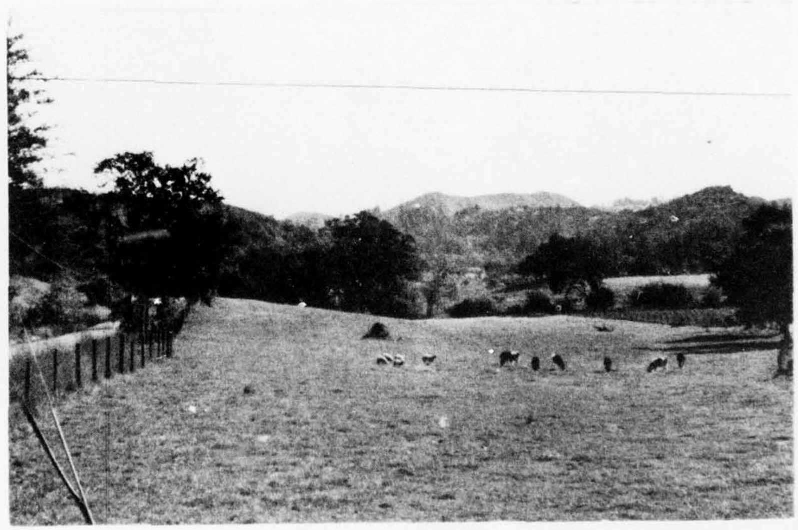
5. NNE Over Franz Valley toward Mount S
Ridge Dividing Franz Valley From Knig
taken from Franz Valley Road 1 1/4 mi
Junction with Porter Creek Road

Site 21

...cross [illegible] River toward NE Bank
...ers Used for [illegible] Implacement (Bank
Protection)

. SE Slope of [illegible] Creek Drainage in Foreground,
Portion of Alexander Valley in Background from
Geyser Rd near [illegible] Winery Road Intersection

...ver Franz Valley toward Mount St.Helena
...Dividing Franz Valley From Knights Valley
...from Franz Valley Road 1 1/4 miles NE of
...on with Porter Creek Road



[illegible]. E Along Franz Valley School Road Up S Arm of
Franz Valley in Proposed Knights Valley Dam Site

7. WNW Scan of Knights Valley from Franz Valley Road near Intersection of Spencer La
Mountains with Mayacm

. S-SSE View from Mid Elevations of Mayacmas Mountains above Knights Valley from Ida Clay
just WSW of Sugarloaf Hill

Site 21

near Intersection of Spencer Lane also in Dam Site with a NNW Scan of Knights Valley Mountains with Mayacmas Mountains on Horizon

Knights Valley from Ida Clayton Rd

9. SW on Maacama Creek from Chalk Hill Road about a mile from Highway #128

a. Geology and Hydrology

Summary of Geology: The oldest subsurface strata in Site 21 are composed of the sedimentary and meta-sedimentary rocks of the Franciscan Assemblage (late Mesozoic, 60 to about 140 million years old, i.e., from the upper Cretaceous to the older upper Jurassic) and Mesozoic ultrabasic intrusive rocks (Jurassic period; 130 to 155 million years old) both of which are considered the "basement" formation in the area. The Franciscan Assemblage is composed of graywacke, shale, conglomerates, and chert together with minor lenses of limestone, glaucophane schists and related metamorphic rocks. The formation underlies almost all of the hills and mountainous uplands east of the Alexander Valley (Sub-Area 21.1), all those in the north central 21.2 and central 21.2 (practically enveloping Knights Valley from the west) and extending southerly generally between Bell Mountain and the Bald Hills. The formation includes significant pockets of Franciscan volcanic and meta-volcanic rocks (greenstone, basalt, diabase.) Mesozoic ultrabasic intrusive rock formations are composed of serpentine, peridotite, dunite, and pyroxenite together with minor amounts of silica-carbonate rocks derived from the alteration of serpentine; they are scattered in many pockets underlying the highest elevations along the eastern perimeter of the Alexander Valley, in the northern part of Sub-Area 21.2 in a general line between Ingalls Bluffs and Mt. St. Helena, in a pocketed line between Black Mt. (northeastern 21.1) and Peter Hill (northcentral 21.2,) and in a short pocketed line passing through the highest elevations in the Russian River "S" meander area of western Sub-Area 21.2. (Refs. 2, 9 and Section A-3a.)

Mesozoic-lower Cretaceous (about 100 to 130 million year old) marine sedimentary rock strata underlie almost all the hills and low mountainous uplands west of the Alexander Valley and a major part of those in the Russian River "S" meander area of western Sub-Area 21.2. They are composed of shales, siltstone, sandstone, massive conglomerates, and local detrital serpentine. Pliocene (Cenozoic-Tertiary, 1 to 12 million year old) volcanic pyroclastic rock strata underlie the eastern part of 21.2 enveloping all but the lowlands of Franz Valley and the eastern lowlands of Knights Valley. These igneous and meta-igneous rocks are composed of tuffs, tuff breccias, agglomerates, water-laid sands, gravels, diatomaceous clays and silts, and minor pumice and perlite. Lower Plio-Upper Pleistocene (Cenozoic-Tertiary, from under 1 million to 6 million years old) non-marine sedimentary deposits underlie most of southwestern Sub-Area 21.3 east of Eastside Road and seemingly under the areas over 100 feet in elevation, all of the hilly and low mountainous uplands in the northern and eastern parts of 21.3, and almost all of similar terrain in the west central part of Sub-Area 21.2 east and southeast of the Russian River "S" meander area. These sedimentary strata are composed of poorly sorted silts, gravelly

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clays, sands and gravels together with basal reworked tuff beds. The last significant sedimentary stratum is composed of recent (Cenozoic-Quaternary, well under 1 million years old) stream and valley alluvium which underlies the lowlands, particularly those of the Alexander Valley and Knights Valley, those in the immediate floodplain of the Russian River in the Windsor Area (Sub-Area 21.3,) and along the channels of Windsor Creek drainage and in a broad band along the foothill fans of this same drainage sweeping the inner northern and eastern parts of the Sub-Area 21.3.

Site 21 contains many fault lines. One important one is the Healdsburg fault which runs in a line through the uplands along the western perimeter of the Alexander Valley sub-area, through the Russian River "S" meander area, and on into the northeastern corner of Sub-Area 21.3. Another is the Maacama Fault Zone which runs along the eastern perimeter of the Alexander Valley southeasterly seemingly in the direction of the Bald Hills of Sub-Area 21.2. There are a number of other fault lines parallel to this and northeasterly of it in the general vicinity of the northeastern part of Sub-Area 21.2.

Summary of Hydrologic Systems and Water Quality Conditions: Site 21 is entirely an area within the Russian River drainage in the reach of the river defined by the Study Site's limits. Sub-Area 21.1 is composed of many small drainage basins directly tributary to the Russian River through the flatlands of the Alexander Valley. The largest are tributary from the north and they include Sausal, Gird, Miller, and Crocker Creeks. Sub-Area 21.2 is dominated by the Maacama Creek watershed which drains into the Russian River just north of Chalk Hill. This watershed covers about 80 percent of this sub-area. Its major tributaries are Redwood Creek (and Knights Valley,) and Franz Creek. Other identifiable drainage units are the Brooks Creek watershed in southcentral 21.2 and the Russian River "S" meander area. Sub-Area 21.3 is dominated by the Windsor Creek watershed north Airport Blvd. Windsor Creek is a tributary of Mark West Creek which in turn drains into the Russian River southwest of Site 21. The major portion of the remainder of Sub-Area 21.3 is composed of the east floodplain of the Russian River south of Healdsburg and some small direct small drainages in the sub-area's northwest corner. A small part of the sub-area's southeast corner is within the direct drainage of Mark West Creek.

Significant groundwater basins underlie two areas of Site 21. One underlies the Russian River in the Alexander Valley, primarily east of the river. The largest groundwater basin underlies the Russian River and all the lowlands of the Windsor Creek drainage within Sub-Area 21.3; it is a northerly extension of the groundwater basin underlying most of the Santa Rosa-Cotati Valley and it extends further north under the Russian River in the westernmost tip of Sub-Area 21.2 and on up the Dry Creek channel.

Estimated water quality conditions for the surface and groundwaters in and around Site 21 are presented in Table V-E-1. The surface waters appear to range in hardness from soft to very hard while the groundwaters appear to be generally moderately hard. The predominant ions in the surface waters are reportedly calcium, magnesium, and bicarbonate. In general, current water quality is fairly good.

b. Soils

The soils of Site 21 represent a typical complex mix of the azonal soils of mountains and geologically young mountain valleys complete with lithosolic (stony, gravelly) and regosolic (alluvial) soils. They are very generally classified as non-calcic chestnut and brown type warm dry soils, with nearly black, friable, organic-rich topsoils and subsoils without any large accumulations of calcium carbonate or gypsum (Ref. 2.) The mean annual soil temperature is over 47°F. There is little evidence of any development toward the stratification typical of the podzolic soils which are typical for the geologically older mountainous and/or coniferous forest regions (i.e., significant leaching in the surface layers under the humus top cover together with a dense clayey subsoil.) The potential and/or historical natural vegetative cover for the Site Area is largely fir and spruce type conifers. More detailed soil information concerning the specific identified soil associations found in Study Site 21 is presented in Tables V-A-2, 3, 9 and 10 (background reference Section A-3c, Ref 10h.)

The largest and somewhat lithosolic soil grouping is composed of brownish, predominantly acid, generally gravelly loam topsoils in combination with generally darker, somewhat more acid, less gravelly and more clayey loam subsoils. This soil group covers about 42 percent of the surface area of Site 21 and is concentrated in Sub-Areas 21.1 and 21.2. These soils are found at elevations ranging from 300 to 4000 feet and on gently to moderately sloping to very steep uplands, but primarily on the steeper uplands. This soil grouping includes, in order of importance, the Jiggs-Kidd-Rockland, Goulding-Toomes, Los Gatos-Henneke, Hugo-Laughlin-Josephine, and Los Gatos-Henneke-Mayman associations. These soils are derived from basic and acid igneous and assorted volcanic materials (such as tuffs and breccias,) from weathered basic igneous materials such as basalt and andesite, from weathered fine grained hard sandstone, shale, and metamorphosed serpentine and ultra basic rock materials, and from weathered fine grained hard sandstones of the Franciscan Assemblage and from shales of similar geological age. Among the more distinctive soils in this group are the Jiggs soils, composed of neutral to strongly acid light gray gravelly loam topsoils in combination with medium acid white gravelly sandy clay loam subsoils over weathered grayish white rhyolite substratum (20-40 inches

Table V-E-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 21

Water Quality Characteristics	Surface Waters[1]	Ground Waters[1]	Current Standards[3]
Total Dissolved Solids	51-226 mg/l	about 300 mg/l	150 mg/l median (RR mainstem) 170 mg/l maximum (RR mainstem)
Electro-Conductance	-----	338-600 microhos[2]	250 median (RR mainstem) 320 maximum (RR mainstem)
Total Hardness	40-232 mg/l	about 64 mg/l	no numerical standards
Total Non-CO_3 Hardness	0-61 mg/l	-----	nns
pH:	-----	7.0-8.2[2]	6.5-8.5 (RR mainstem)
Temperature	60-64°F median	63-80°F[2]	nns
Sediments (General Area Estimates)	280-1950 mg/l	-----	nns
Ca	-----	3.8-45 mg/l[2]	nns
Mg	-----	1.6-56 mg/l[2]	nns
Na	11-23%	about 74% 9.6-132 mg/l[2]	nns
HCO_3	-----	233-324 mg/l[2]	nns
Cl	-----	about 48 mg/l 6.4-39 mg/l[2]	nns
B	0-3.0 mg/l	about 0.9 mg/l	nns
SO_4	-----	about 6 mg/l	nns
Dissolved Oxygen	-----	-----	10 mg/l median (RR mainstem) 7.0 mg/l minimum (RR mainstem)
NO_3	-----	-----	1.5 mg/l median (RR mainstem)
PO_4	-----	-----	0.06 mg/l median (RR mainstem)
Coliform Organism (Most Probable No.)	-----	-----	50/100ml (for disinfected wastewtr)
Chlorine Residual	-----	-----	0.1 mg/l (for disinfected wastewtr)

1. From Ref. 7 and Ref. 6.
2. From Hydrology Data: 1970, Volume III: Central Coastal Area, California State Dept. of Water Resources Bulletin No. 130-70, Dec. 1971
3. From Ref. 14, for surface waters only, primarily for Russian River mainstem

down,) and rockland on the stony steep slopes and ridges. Soil depths range from about 60 inches (Hugo soils) to under 10 inches (Mayman soils.) The topsoils range in pH from strongly acid to mildly alkaline (the slightly acid predominating;) in color from pale and red brown to brown and grayish brown; most are gravelly, very gravelly, or rocky loams; one is a frequently stony and cobbly clay loam; another is a non-gravelly loam. Subsoils range in pH from strongly acid to moderately alkaline (the medium acid predominating;) in color from pale, reddish, and dark yellowish brown, yellowish red to dark and dark grayish brown; half are clay loams (mostly non-gravelly,) the other half being mostly gravelly or cobbly loams. Substratum range from strongly acid weathered gray rhyolite parent material, yellowish-red to dark gray fractured rock (16 to 36 inches down,) weathered basic igneous rock (5 to 25 inches down,) sandstone (about 20 inches down,) highly weathered and metamorphosed serpentine bedrock (10 to 30 inches down,) weathered and shattered yellowish brown sandstone and shale (30 to 60 inches down,) weathered finely grained sandstone (25 to 40 inches down,) weatered sandstones and shales (24 to over 60 inches down,) to sandstones less than 10 inches down.

The second largest soil grouping is composed of predominantly grayish brown and slightly acid, medium textured mixed clay loam and loam topsoils in combination with pale, yellowish, grayish, mottled dark grayish, and regular brown tight clayey subsoils which are generally more acid. This soil group covers about 36 percent of the surface area of Site 21 and is concentrated in Sub-Area 21.2. These soils are found at elevations ranging from 300 to 3500 feet and on gently sloping to steep uplands with about one-fifth being on slopes over 30 percent. This soil grouping includes, in order of importance, the Yorkville-Sutherlin and Spreckels-Felta associations. These soils are derived from highly weathered and metamorphosed basic and glauchophane schist and weathered fine grained hard sandstone materials of the Franciscan Assemblage and from weathered volcanic and basic rocks. The predominant soils are composed of slightly acid grayish brown clay loam and medium acid pale brown loam and clay loam topsoils in combination with mildly alkaline mottled dark grayish brown clay and strongly acid pale brown gravelly clay subsoils. Their substratum are composed of dark gray or black metamorphosed basic and glaucophane schists (30 to 60 inches down,) and weathered and shattered finely grained sandstone of the Franciscan Assemblage. The other soil component is composed of slightly acid grayish brown loam topsoils in combination with slightly to strongly acid brown to grayish brown clay subsoils. Their substratum are composed of strongly acid brown to yellowish brown basic rock fragments and volcanic ash.

The third significant (and regosolic) soil grouping is composed of young soils with coarse to medium texture which have developed on recently deposited alluvium in the level to gently sloping fans and floodplains of the

Study Site. This soil grouping covers about 21 percent of the area of the Site. It predominates in Sub-Area 21.3 specifically and is generally found in the floodplain of the Russian River and other major tributary streams, at elevations ranging from 100 to 300 feet. The predominant soil association in this group is the Yolo-Cortina-Pleasanton. These predominant soils are composed of (1) sandy loams, loams, and clay loams, slightly acid and grayish brown in the surface layers, neutral to mildly alkaline and brown in the subsurface layers; (2) very gravelly sands, sandy loams, and loams, grayish-brown in general, medium to strongly acid, with acidity increasing with depth, and depths usually over 60 inches; and (3) strong to very strongly acid grayish brown gravelly loam and clay loam topsoils in combination with medium acid, brown to yellowish brown gravelly clay loams and gravelly sandy clay loams.

c. Climatology and Meteorology

The climate of the is characterized by moderate temperatures and precipitation. Mean air temperatures range from about 40-44°F in January and from about 64 to 68°F in July. Night temperatures usually drop into the lower 50's during the warm period. Mean annual precipitation, pan evaporation, potential evapotranspiration, and vegetative requirements for the three sub-areas of the Site are shown in the following (from Table V-A-4:)

Mean Annual:	Site 21 Sub-Areas		
	21.1	21.2	21.3
Precipitation	51.0"	58.0"	37.0"
Pan Evaporation	64.8"	64.8"	64.8"
Potential Evapotranspiration	45.2"	45.2"	45.2"
Vegetative Requirement	28.9"	28.0"	29.6"

About 82 percent of the mean annual precipitation is concentrated in the months of November through March. About 64 percent of the mean annual pan evaporation occurs between May and September. Mean annual evapotranspiration from non-irrigated areas is about 20 inches. Average length of the growing season is about 240 days without killing frosts. Mean annual sunshine is about 2800 to 3000 hours per year. The summer dry period is generally long enough to deplete stored soil moisture and to result in dried range. Winds are relatively light most of the time and generallly blow persistently during the summer. The deflecting of the marine air masses by the coast mountains to the west of Site 21 diminishes the cooling effect of these air masses. (Refs. 2,6,10h,14.)

Summary of Air Quality Conditions: It is estimated that Site 21 currently experiences approximately 10 to 20 days per year of oxidant levels

at or over 0.01 ppm. Background discussion for this has been presented in Section A-3d. The Study Site's proximity to Santa Rosa to the southeast together with the projection of current development rates in the Russian River and Santa Rosa Valley areas would indicate a general increase in these experiences with higher oxidant levels. The degree to which current air pollution control programs, Federal, State, or local, will affect this in the immediate future period is uncertain. (Ref. 142.)

a. Vegetative Cover

Wastewater Application Site 21 (Sonoma County), supports five major vegetative cover types: agriculture, grasses and forbs, chaparral, hardwoods, and coniferous forest (Figure V-E-6.) The agricultural areas are primarily in pasture or vineyards. Mixed grass and open woodland or brush comprise more than 70 percent of Site 21 and are utilized for sheep and cattle grazing. Prime agricultural areas include Alexander, Knights, and Franz Valleys and a portion of the Russian River Valley found in study Area 21.3.

The native perennial grasses of the grasslands areas have been replaced by annual species of Avena, Bromus, Festuca, and other genera. This replacement of species has not been restricted to "improved pasturage", it is most prevailent in the overgrazed natural grasslands.

The chaparral areas are found on some southern and western slopes in the mountainous portions of Sub-Area: 21.1 and 21.2. The western face of Mt. St. Helena and adjacent areas support wide expanses of chaparral. The dominant species in this cover type, as well as, the dominant species of the other vegetative cover types found in Site 21 are listed in Table V-E-2. Chamise and manzanita and Ceanothus species are the predominant forms. In addition to the chaparral areas on and near Mt. St. Helena, other chaparral areas are found in the region of Franz Valley and west of Geyserville.

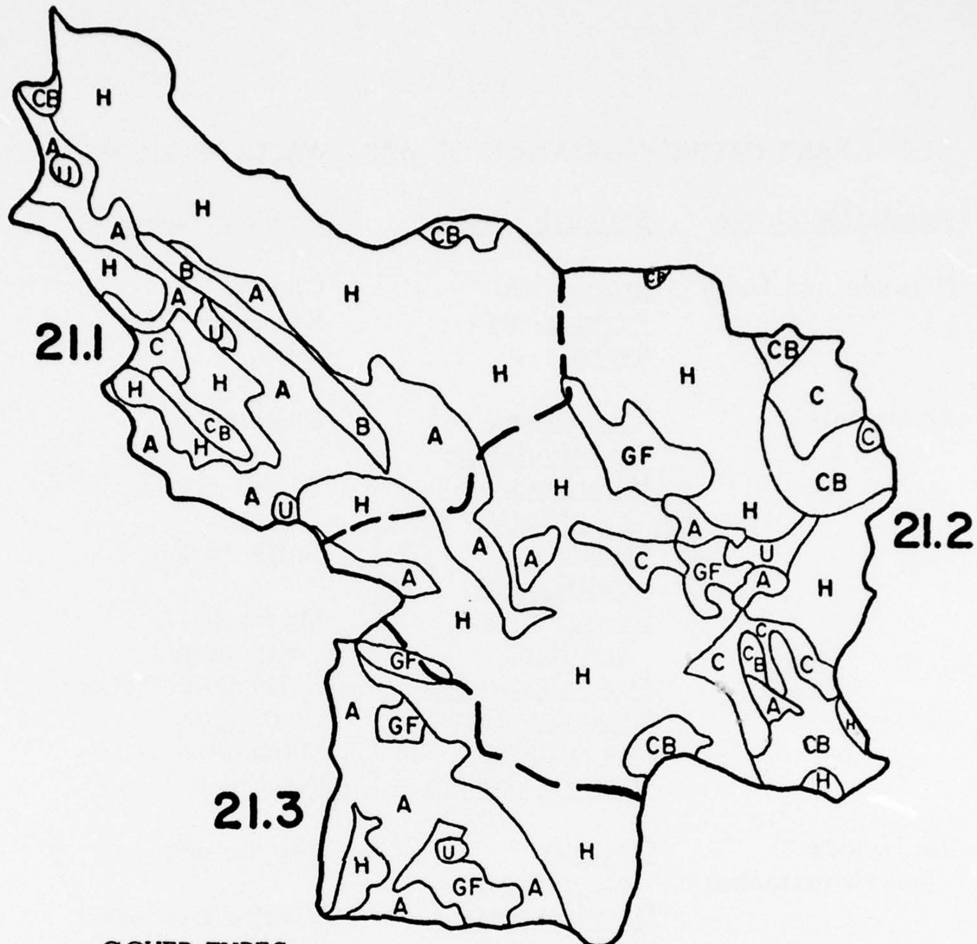
Two different plant associations are found within the hardwood cover type - oak woodlands and mixed evergreen forests (Table V-E-2). Oak woodlands are typified by several different oak species and grasses with little brush or understory. The lack of understory in some areas may be the result of brush clearing to facilitate grazing. The eastern hillsides overlooking Alexander Valley is one area that supports the oak woodland vegetative cover type. The oak woodlands tend to grow on south facing slopes and in broad, flat valleys.

The mixed evergreen forest which supports both oaks and conifers (Douglas fir) is found in areas of higher moisture than the oak woodlands. The mixed evergreen forest grows in narrow valleys on the north side of mountainous areas.

Small areas of coniferous forest cover type remain as redwood forest. Most of the redwood forest in Site 21 has been removed by lumbering.

Figure V-E-6

EXISTING VEGETATIVE COVER IN SITE 21



COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous forest
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

Table V-E-2

DOMINANT NATIVE VEGETATION OF WASTEWATER APPLICATION SITE 21

Vegetative Cover	Scientific Name	Common Name
Grasses and forbs	Bromus ssp.	Chess
	Festuca ssp.	Fescue
	Avena ssp.	Oats
Chaparral	Adenostoma fasciculatum	Chamise
	Heteromeles arbutifolia	Toyon
	Rhamnus californica	Coffeeberry
	Cercocarpus betuloides	Mountain mahogany
	Prunus ilisifolia	Holly leaved cherry
	Ceanothus spp.	Ceanothus
	Arctostaphylos spp.	Manzanita
	Quercus dumosa	Scrub oak
Hardwoods (oak-woodlands)	Quercus chrysolepis	Canyon oak
	Q. wislizenii	Interior live oak
	Q. kelloggii	Black oak
	Q. garryana	Oregon oak
	Acer macrophyllum	Big leaf maple
	Aesculus californica	California buckeye
(Mixed evergreen forest)	Lithocarpus densiflora	Tanbark oak
	Arbutus mensiesii	Madrone
	Pseudotsuga menziesii	Douglas fir
	Umbellularia californica	California bay
	Acer macrophyllum	Big leaf maple
	Quercus chrysolepis	Canyon oak
	Q. kelloggii	Black oak

Table V-E-2 (Cont'd)

Vegetative Cover	Scientific Name	Common Name
Coniferous forest	*Sequoia sempervirens*	Redwood
	Pseudotsuga menziesii	Douglas fir
	Lithocarpus densiflora	Tanbark oak
Riparian	*Vitis californica*	Wild grape
	Alnus rhombifolia	White alder
	Sambucus mexicana	Elderberry
	Salix spp.	Willow
	Fraxinus sp.	Ash
	Populus fremontii	Cottonwood

Redwood areas are located along Franz Valley Road, south of Knights Valley, north of Mt. St. Helena and west of Geyserville. Rare, endangered, and possibly extinct plants whose distribution may include Site 21 are listed in Table V-E-3.

b. Fish and Wildlife

Fisheries: The Russian River is the major year-round stream in Site 21 and the entire Site Area is contained within its watershed. Important tributaries to the Russian River include Franz, Kellogg, and Maacama Creeks. On October 18, 1972, both Franz and Kellogg Creeks were clear and had low flows. Maacama Creek waters varied in depth, some areas having considerably more water than others. Water in all of the creeks was clear and warm. Reaches of streambed gravels and bars free of sand were observed. These streams support a resident trout fishery. These trout populations and their territorial distribution are dependent upon a number of critical stream quality factors.

Anadromous Fish. Salmon and steelhead are the most important anadromous fish of Site 21. Chinook (King) Salmon spawn in the larger tributaries and coho (Silver) salmon in the lower parts of the drainage. Steelhead are found in most tributaries of the rivers. Salmon of the Russian River provide 10,000 angler-days per year with a yield of 0.2 fish per angler day. Steelhead of the Russian River provide 60,000 angler-days per year with a yield of 0.2 fish per angler day.

Warmwater Fish. During the summer the waters of tributaries become warm and fishing is limited to warmwater and non-game species, - mainly of the families Centrarchidae (sunfish), Catostomidae (suckers), Cyprinidae (minnows), and Ictaluridae (catfish).

Few farm ponds are in the area, but warmwater fishing could be available in those ponds on a year-round basis. In one location of Knights Valley trout are raised commercially for fishing in "catch out" ponds. See the Appendix (Chapter K) for a complete list of all fish occurring in Site 21.

Wildlife: Seven wildlife habitat types are found in Site 21. They are: redwood forest; woodland grass; grassland agriculture; chaparral; hardwood; woodland chaparral; and riparian. During a one-day survey of the area, 26 birds and 6 mammalian species were observed within the Site boundaries. The animal species observed are listed in Table V-E-4. Animal species whose distributions include wastewater management Site 21 are included in the Appendix (Chapter K.)

Table V-E-3

WASTEWATER APPLICATION SITE 21
RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS

Species*	Local Habitat	Plant Community
Plagiobothrys strictus	Sulfur springs near Calistoga	
Strepthanthus brachiatus	No data	
S. morrisonii ssp. hirtiflorus	No data	
S. morrisonii ssp. morrisonii	No data	
Panicum thermale (Panic grass)	Wet saline places about hot springs	
Lupinus abramsii	Open woods	Mixed evergreen forest
	200-5000 feet	Yellow pine forest
Erythronium helenae	Well-watered volcanic soil and leaf mold, in brush and woods	Chaparral Foothill woodland
	Mt. St. Helena	
Linnanthes vinculans	No data	
Navarretia plieantha	Peaty margins of Bogg's Lake	Yellow pine forest
Eriogonum kelloggii	Dry ridges	Yellow pine forest
	4000 feet	
Potentilla hickmanii	Rare - in marshy places at scattered stations	Foothill woodland
Lomatium repostum	Inner coast ranges	Chaparral
	Mt. St. Helena	Closed-cone pine forest
		Foothill woodland

*Note: All of the listed plants are annual grasses or forbs; most have no common name

Table V-E-4

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS
ON OCTOBER 18, 1972
OF WASTEWATER APPLICATION SITE 21

Birds	Mammals
Great blue heron	Gray squirrel
Common egret	Golden mantled ground squirrel
Turkey vulture	Black tailed jackrabbit
Red-tailed hawk	Brush rabbit
American kestrel	Black-tailed deer
California valley quail	
Common coot	
Mourning dove	
Band-tailed pigeon	
Red-shafted flicker	
California acorn woodpecker	
Hairy woodpecker	
Stellar's jay	
Scrub jay	
Common crow	
Common bushtit	
Mockingbird	
Robin	
Cedar waxwing	
Brown towhee	
Rufous sided towhee	
Meadowlark	
Brewer's blackbird	
Oregon junco	
Black headed grosbeak	
House finch	
White crowned sparrow	

Big Game. Coastal black tailed deer are found in densities (30-60 per square mile) in most wildlands, but they are probably the most abundant in the woodland-chaparral habitats (Ref. 32.) Particularly good deer range is located in Franz Valley, the Kellogg Creek area, and the area west of Mt. St. Helena. In particularly good oak grassland areas, deer populations may be as high as 100 per square mile. Deer densities are 10-30 per square mile in agricultural and grassland type habitats, particularly in Knights Valley. Deer depredation is a serious problem in Sonoma County, especially in orchards and vineyards. (Ref. 32.)

Feral pigs and wild boar are found in the coastal range, but their density in Site 21 is not known. They may be common, but are probably not abundant. Bear are common in the uninhabited north coastal forest areas and occur in reduced numbers in Sonoma County.

Mountain lion are sparse, but have been observed in the rimrock and brush areas on Mt. St. Helena. Lions attempt to impose territorial hunting ranges covering 10 to 20 miles per individual, depending upon the relative population of deer and lions.

Upland Game. "Good" populations of California valley quail and mountain quail are found in Site 21. California quail occur in the greatest numbers in chaparral and riparian habitats. Mountain quail are most common in the coastal coniferous forests. Populations of 190 to 380 per square mile are common for California valley quail in most wildland habitat.

Wintering populations of band-tailed pigeons are found locally in densities of 64 to 640 per square mile. Sonoma County in 1971 and previous years was one of the top 10 counties for hunter take of band-tailed pigeons. In 1965, 250 wild turkeys inhabitated the woodland-grass habitat in the vicinity of Cloverdale. Today, approximately 30 to 40 of those birds remain.

Ring-necked pheasants are found in the agricultural areas in Knights Valley, but because of poor habitat they are not found in large numbers.

Small game mammals found in Site 21 include black-tailed jack-rabbits, brush rabbits and gray squirrel. Jackrabbits prefer open agricultural land and fields. Brush rabbits have optimum habitat in dense brush or riparian vegetation near open fields, similar to California quail. Gray squirrels are arboreal, preferring riparian vegetation oak woodland, and coastal forest habitats.

Waterfowl. Migrant ducks and geese are not common in Site 21 because the habitat is not suited for their needs. Marshes and ponds

are few in number and small in size. Fallow grain fields and other feeding stations are not available since agriculture is mainly vineyards and permanent pasture. Wood ducks breed in densities of 60 per square mile along streams and farm pond areas.

Non-game Wildlife. White-tailed kite occur in the grassland and agricultural habitat types on densities of 6 per square mile. Song birds are plentiful in nearly all habitat types, but dense riparian vegetation and brush are favored habitats for many song birds.

For a complete list of all wildlife species found in Site 21 see the Appendix (Chapter K.) Table V-E-4 lists all wildlife observed in the area during field observations.

Rare and Endangered Species: Fifteen animal species, known or thought to occur in Site 21, are considered by state and/or federal authorities to be rare or endangered (see the Appendix, Chapter K.) They are listed in Table V-E-5.

Fish. The white sturgeon occurs throughout the Sacramento-San Joaquin Delta, the Sacramento River, and the Russian River in small numbers. Sturgeon were once very abundant, but numbers have diminished.

Reptiles. The Alameda striped racer occurs in the east Bay area. It inhabits the chaparral, but may occur in grassland, open woods and rocky slopes. This animal could occur throughout Site 21, especially in the chaparral areas on the west and south slopes of Mt. St. Helena.

Birds. The tule white-fronted goose and the Aleutian Canada goose are winter visitors to California. Geese could use Site 21 valley land as resting areas. Since very little of the area is suitable geese habitat, they probably would not remain long.

Hawks and falcons nest in trees in riparian areas, oak woodland, and coniferous forests. The peregrine falcon will nest on cliffs when they are available. They are all tertiary predators; the prairie falcon and American peregrine falcon feed primarily on birds, while the osprey is a fish eater. Pesticide poisoning, malicious shooting, and human encroachment upon feeding and nesting areas are the major reasons for their decline. American peregrine falcons have been taken illegally by falconers.

The mountain plover is a winter visitor in central California. Its habitat consists of semi-arid grassland, plains, and plateaus. The Alaskan short-billed dowitcher is a winter visitor from central California south. Its habitat consists of mudflats, open marshes and ponds. The California

Table V-E-5

RARE AND ENDANGERED ANIMALS OF SITE 21

Common Name	Status	Occurrence
Fish		
White sturgeon	U	x
Reptiles		
Alameda striped racer	R	x
Birds		
Aleutian Canada goose	E	*
Tule white-fronted goose	E	*
Red-bellied red-shouldered hawk	U	*
Ferruginous hawk	U	x
Southern bald eagle	E	x
American osprey	U	x
Prairie falcon	R	*
American peregrine falcon	E	*
Mountain plover	U	*
Alaskan short billed dowitcher	U	*
California yellow-billed cuckoo	R	*
Yakutat fox sparrow	U	*
Mammals		
Pine marten	U	*
Fisher	U	*

E Endangered

R Rare

U Uncertain

* Occurrence of this species or subspecies on the wastewater management area is uncertain or questionable.

x This species or subspecies definitely or probably occurs on the wastewater management area.

yellow-billed cuckoo is a resident bird inhabiting dense riparian brush. Destruction of habitat by development and channelization of stream sides has contributed to its decline in numbers.

The pine marten and fisher both prefer coniferous forests in remote areas away from man's activities. They are valuable furbearers, which is probably one reason for their decline. Densely forested ridges and ravines of the inner coast range are suitable habitat, but the existence of the species in Site 21 has not been confirmed.

An addition to the above mentioned species, mountain king snakes and ring-tailed cats were considered by Sonoma County planning staff to be critical wildlife species. They have been seen in diminishing numbers in the Mt. St. Helena area.

Wildlife and Fish Diseases.

Wildlife Disease. The same considerations concerning wildlife disease and the infections common to domestic and wild animals described for Site 18 are the same for Site 21, although the pasture lands would be more restricted and crop lands more extensive on a relative basis.

Fish Diseases and Parasites. The fish diseases and parasites found in Site 21 will be essentially the same as those found in Site 4. Special consideration must be given to diseases of salmonids (SCRD, "whirling disease, and IPN) in this area. The Russian River and its tributaries located in this area are important migration routes and spawning areas for chinook and coho salmon, and steelhead rainbow trout. Refer to the discussion of fish diseases and parasites found in the present environment section of Site 4.

c. Ecological Systems

There are several important wildlife ecosystems found in Site 21. They include the riparian habitat, brush and grasslands, and woodland.

Riparian vegetation adjacent to streams and rivers, such as the Russian River, Maacama Creek, Redwood Creek and Franz Creek, is located in Site 21. They often support two different categories of animals. One, animals that utilize the water as forage and feeding areas, and two, animals that use the riparian vegetation as cover for "homes". California quail may use the dense riparian brush as cover, while a raccoon may forage on the streamside of the riparian zone.

The diversity of animals in a riparian zone is dependent upon the diversity of plant life. A riparian zone consisting of trees, brush and grasses (with interspersed open space) will support a greater variety of animals, than the same area would if it consisted of only brush. Any environmental or man-made factor that influences the composition of streamside vegetation will affect the associated wildlife.

Grassland, chaparral and oak woodland all have animal species that are representative of the area. The California ground squirrel would be a representative animal of the grassland. The California acorn woodpecker is most abundant in the oak woodland and might therefore be considered a representative species of that vegetation type. All vegetative types may have several animals that may be categorized as "representative" of the area, but the greatest diversity of animal species occurs when there exists an "interface" between two or more vegetative types (ecotones). In ecotonal areas animals from both habitat types may exist along with versatile animals that are found in two or more habitat types.

Much of the eastern boundary of Site 21 consists of ecotonal areas, particularly in the area west of Mt. St. Helena, Knights Valley and Franz Valley areas. Refer to the vegetation cover types, Figure V-E-6, for ecotonal areas between adjacent vegetative types.

The Russian River and its tributaries are important spawning and nursery areas for anadromous fish species and their young. Adequate flows of water are necessary for these migrating fish to reach spawning areas. Important salmon and steelhead spawning migrations often occur in the autumn when stream flows may be at their lowest point. Clean water and stream gravels are required for successful spawning or hatching. Silt deposits are detrimental. Streams must be passable to ascending adult fish and descending juvenile fish. Obstructions blocking streams will prevent adult fish from reaching spawning areas and young fish from escaping to the ocean.

In addition to natural decimating factors, migrating fish also face increasingly serious threats to their survival from development and pollution. Increased silt loads accompanying ubiquitous development is the most serious pollutant. Other pollutants include heavy metals, organic wastes, and thermal effluent. Gravel dredging operations also destroy spawning beds and create heavy siltation problems.

d. Recreational Resources

The gross recreational user potential available to Site 21 is estimated at 105 million visitor days per year. A lack of public lands limits actual use of the area, especially the upland regions. Where access is available, salmon and steelhead fishing on the Russian River and its smaller tributaries is quite popular and successful. Hunting is limited primarily to deer and quail. Other activities include camping, hiking, picnicking, sightseeing, horseback riding, canoeing and kayaking.

Present Public Facilities: The Bureau of Land Management's 7,000-acre holding at Pine Mountain and a portion of the 3,139 acre Robert Louis Stevenson Memorial State Park are the only publicly owned recreation sites in Site 21. Both are primarily day-use facilities with no improved camping or picnicking sites and very limited access. Hiking trails are the only recreational improvements in either area.

Present Private Facilities: The preponderance of private landholdings in Knights and Alexander Valleys and their surrounding hillsides has channeled most recreational activity into private concerns. Camp Maacama, Charles W. Elsbree Park and Rancho Los Ojitos are popular camping, hiking, and horseback riding areas which are privately owned and operated. Camp Maacama occupies about 100 acres; it contains 15 parking units, 10 camping units, and about 3 miles of trails. Charles W. Elsbree Park occupies about 500 acres; it contains 20 parking units, 10 camping units, and about 3 miles of trails. Rancho Los Ojitos occupies about 1,200 acres; it contains about 10 miles of trails. Estimated current usuage for these three is 5,500, 2,300, and 4,000 visitor days per year respectively. Projected year 2000 usuage is 9,300, 3,900, and 6,800 visitor-days per year, respectively.

Field investigations of Site 21 has revealed the presence of several other private recreation operations. Thunderbird Ranch on State Highway 128, approximately 3 miles south of Alexander Valley, offers camping, swimming, horseback riding and picnicking to summer recreators. Camping and picnicking facilities are also available for a fee at Alexander Valley Campground, located just west of the Russian River on Alexander Valley Road.

Smaller facilities worth brief mention are as follows: canoe rental sites on the Russian River at Asti and Alexander Valley Road; the Geyser Rifle and Pistol Club on U. S. Highway 101 two miles north of Geyserville; and Mt. St. Helena Trout Farm on Ida Clayton Road approximately 7 miles north of Kellogg.

The American Whitewater Affiliation (AWA) has estimated that private canoeing and kayaking clubs, rental boaters and unattached boaters expend

25,000 to 50,000 man-days per year rafting, canoeing, and kayaking down the Russian River from Ukiah to the ocean. These waters rate AWA boating difficulty ratings of Class I and III (Ref. 30.)

Hunter and Angler Use: The 1970 California Department of Fish and Game estimates of bag and hunter numbers for Sonoma County's main game species are listed in Table V-E-6; these figures represent the only comprehensive hunter use estimates available for Site 21.

Table V-E-6

1970 Hunter Survey - Sonoma County*

	Bag	Hunters
Pheasant	6,800	4,000
Quail	29,200	4,500
Dove	34,400	3,900
Pigeon	4,000	1,000
Jackrabbit	35,800	2,500
Cottontail	1,900	500
Tree squirrel	9,900	1,300
Ducks	35,100	3,300
Geese	500	200
Jacksnipe	5,400	900
Coots	11,900	500
Deer	2,800	7,500

* Extracted from unpublished records, Calif. Dept. Fish and Game, Sacramento, California.

The 1972 Wildlife Management Unit Reports of the California Department of Fish and Game estimate the 1969-1971 3-year deer kill average to be 1,610 for the North Bay management unit. This area includes all of Sonoma and Marin Counties and thus is not site-specific for Site 21.

The Russian River, which flows through the western portion of the study area, is rated as a Class I salmon, steelhead and warmwater fishery in the California Protected Waterways Plan. Again, angler use data specific to Site 21 are not available but estimates for the entire Russian River have been made by the California Department of Fish and Game. Salmon fishing

draws 10,000 angler-days per year use yielding about 0.2 fish per angler-day; steelhead fishing consumes 60,000 angler-days per year yielding a success of about 0.2 fish per angler-day. Warmwater fishing estimates are not available (Ref. 32.)

Open Space: Sonoma County, like many of the counties in California, is at present writing a new open space element to their county general plan in order to meet current state planning standards. Until that new element is completed, the 1964 Recreation Plan 1985 is the document of record for Sonoma County open space policy.

Within Site 21, there are five separate land categories that represent open space on the 1964 plan map. Generally, all lands west of the Russian River and the Bald Hills (excepting urban areas at Healdsburg and Geyserville) are designated as rural area and are expected to be slowly developed. The steeper slopes east of the Russian River and north of Maacama Creek and the higher portions of the Bald Hills are currently classed as watershed. The remaining uplands south of Maacama Creek are conservation areas and are being maintained in an undeveloped state to take advantage of their scenic and recreation potential. A commercial recreation area east of Healdsburg on the Russsian River is planned to incorporate high use recreational development with an urban atmosphere. The final open space designation, regional parks, is scheduled to include state parks at the Petrified Forest and Mt. St. Helena; a county park at Mark West Springs; and a municipal park west of Healdsburg on the Russian River.

Future Public Facilities: Two state recreation developments are proposed within Site 21's boundaries. One, at Robert Louis Stevenson Memorial State Park, is simply an expansion of an existing facility. The expansion is not being actively pursued at this time, but is schecduled to include lands down the western slope of Mt. St. Helena. The other state area, at the Petrified Forest, is also an inactive project at present. No land acquisition has yet taken place.

Sonoma County has plans for a wayside park at the junction of Redwood Creek and the Russian River, but at present no money or lands have been allocated to the project (Sonoma County Planning Department, 1964).

e. Protected Waterways Designations

The Russian River is the only waterway with a "protected" status in Site 21. It is classified as follows:

1. Class I premium scenic, fishery, wildlife and recreational waterway.

2. Class I salmon, steelhead stream, and warmwater stream.

3. In the fisheries waterways evaluation it is classified as Class II salmon river, a Class I steelhead river, and a Class II shad waters (mouth to Healdsburg Dam).

4. Class I inland marsh and wetland.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

The archaeological potential of Site 21 primarily reflects the historic and relatively heavy populations of Pomo Indians who inhabited the area. It is estimated that an archaeological site exists about every half-mile along any of the Site's many drainage channels (Ref. 11.)

Site 21 has what may be considered four significant historical landmarks located within or immediately adjacent to its limits; only one being a registered State land mark (Refs. 11, 15.) The Italian Swiss Colony at Asti in the north end of Sub-Area 21.1 is California Registered Historical Landmark No. 621. This agricultural colony was established in 1881 and has subsequently become a celebrated wine producing enterprise. The historical landmark monument is erected just outside the Colony's wine tasting room, this being located north just off the Asti Road segment of the Old Redwood Highway opposite the Asti off-ramp from the US 101 freeway. The Colony's pioneer "Church of Our Lady of Mount Carmel" is the second landmark; it is located about 1000 feet north of the Colony's wine tasting rooom (see Figure V-E-5a.) The third landmark is part of the adobe house of Cyrus Alexander built in 1845-46. The house was destroyed in the 1906 earthquake and has subsequently been incorporated in the structures of the Alexander Valley grammar school. It is located just south off SR 128 near East Soda Rock Lane in Sub-Area 21.2 (just south of the boundary with Sub-Area 21.1.) Thr fourth landmark is the burial grounds of the pioneer family of William Marcus West in the Spanish land grant of Rancho San Miguel located "in the rolling hills of Mark West Creek." Investigation indicated that its most probable location is just outside Site 21; in the front yard of an old homesite situated just west off a north-south leg of Mark West Springs Road located south of the community of Mark West Springs (due east of the eastern perimeter of Sub-Area 21.3.)

b. Scenic Locations

There are two "corridors" officially designated by the State of California as scenic within Site 21. The first is a corridor along the Russian River; it has been designated as a premium (Class I) scenic waterway in the California Protected Waterways Plan from Ukiah through the Site Area and on down to its mouth. The second is SR 128 and Red Winery Road between Geyserville and the community center of Alexander Valley (in Sub-Area 21.1) which together form a scenic drive that has been officially designated as such by Sonoma County. There are no current or proposed state scenic highways within the Site. (Refs. 30, 39, 92.)

Apart from official scenic designations, the Study Site has many commanding vistas which show off the beauty of the low rugged and timbered mountains and the small valleys of the Site. Some of these are indicated in the view presented in Figures V-E-5a and 5b.

These scenic values are somewhat marred by the near universal appearance of roadside refuse scattered all along the edges of the Study Site's many roads, major and minor, and which are concentrated particularly at natural and specifically provided stopping and pull-off viewing areas. The universal "indicator" of this is the beer can.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact of wastewater land application would be a change in the temperature of waters receiving wastewater runoff.

Discussion: An increase in the water temperature of the Russian River, Maacama Creek, Redwood Creek and Franz Creek could seriously impair or destroy salmon, steelhead and sculpin populations. Temperature requirements of the anadromous salmonids are:

Migration routes (adults	-	45-68^{o}F
Spawning areas	-	45-55^{o}F
Rearing areas (juveniles)	-	50-68^{o}F

Water temperatures found in the Russian River near Healdsburg during the time of migration range from 44-63^{o}F. Water temperatures in Franz Creek range from 44.5 to 69^{o}F. Low flows in Franz Creek in the summer will frequently cause an increase in the water temperature. Temperatures for Maacama Creek, which is a major tributary to the Russian River, range from 45 to 67^{o}F. During extremely low ($<$2 cfs) flows in the summer, water temperature may rise to 77^{o}F.

Water temperatures exceeding 68^{o}F for any long period of time may kill silver salmon fingerlings which remain in freshwater streams for up to two years before downstream migration. Young steelhead which may stay in a stream for one year may be similarly affected.

Wastewater warmed by the sun for long periods of time, such as during row crop irrigation or pasture flooding, could infiltrate into the subterranean water supply and raise the mean temperature of this water. Groundwater eventually drains into nearby streams and thereby may regulate the mean water temperature of streams. A warmed subsurface water would raise stream temperatures.

Remedial, Protective and Mitigation Measures: Restrict input water temperatures of coldwater streams to levels within optimum salmonid requirements.

Limit wastewater application to drainages without important salmonid populations.

Undertake studies to measure potential effects of this impact.

b. Impact 2

The second impact would be the loss of vegetation, wildlife habitat and wildlife on areas used for disposition of excess excavation resulting from construction of project features.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 13 for Site 4 (Section B-6m).

c. Impact 3

The third impact would be the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 4 (Section B-6l).

d. Impact 4

The fourth impact would be the change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion: The application of wastewater in the amount proposed (90.0 acre-feet per acre per year) to the rapid infiltration areas would eliminate all present vegetation and create marsh land. Knight's Valley, Alexander Valley, south Healdsburg area (Sub-Site 21.3) are the areas that will receive the greatest impacts.

Remedial, Protective and Mitigation Measures: A change in ecosystems would produce a direct loss of the existing flora and fauna, while gaining a new species association on the newly developing habitat. The loss of the flora and fauna of the ecosystem cannot be mitigated in place or in kind. Management measures need to be taken to provide the most beneficial replacement community. To lessen the changes to the ecosystem, less wastewater would have to be applied. Animal species that would be affected by a change in ecosystems can be ascertained from the species list (Appendix A) by examining the habitat and food habits column of these tables. For example, the creation of marsh or wet meadow

habitats in the rapid infiltration areas would create habitat more suitable for marsh dwelling animals. Marsh dwelling mammals, such as raccoons, and marsh dwelling birds, such as herons and egrets, would appear. The typical new environment may be determined when a more detailed management plan is proposed.

The creation of marsh lands, while an adverse impact for the agricultural associated wildlife on the pre-existing cropland, will provide habitat for the many species which are dependent on a marsh environment. As marsh lands statewide have been seriously reduced in acreage with the encroachment of man, production of permanent marsh habitat would be beneficial and a valuable ecosystem in view of the limited amounts of marshland presently available.

e. Impact 5

The fifth impact would be the change in the micro-climate caused by the increased available moisture.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 4 for Site 5 (Section C-6d).

f. Impact 6

The sixth impact would be the possible accelerated eutrophication of surface waters in Site 21 by increased biostimulants.

Discussion: Recovered wastewater draining into the Russian River and its tributary streams by surface and subsurface drainage will increase biostimulants in the water. The estimated quality of recovered water is:

	Surface Drainage	Subsurface Drainage	
		Forest Pasture, and Crop	Rapid Infiltration
Total nitrogen (TN)	6-20 mg/1	3-20	21-70
Total phosphorous (TP)	2-4	1-2	1-2

TN and TP objectives have not been set by the North Coast Water Quality Control Board for discharge into the Russian River. But, they do prohibit the discharge of biostimulants "which promotes aquatic growths in the receiving waters to the extent that such growths cause nuisance or damage any beneficial use."

The consequences of increasing biostimulants to these levels would be the creation of algal "blooms" which in turn may be odoriferous and unsightly. Total nitrogen levels higher than 1 mg/l and phosphorous levels about 0.1 mg/l generally encourage noticeable growth of algae. The Russian River near Healdsburg had total nitrogen concentrations of 0.21 mg/l (August 1966).

The oxygen requirements by algae during indigenous respiration and during decomposition may cause oxygen depletions serious enough to impair fishlife.

The unsightly appearance of water experiencing algae blooms and the possibility of fish kills will reduce the recreational potential of the resort area.

Remedial, Protective and Mitigation Measures: Monitoring of all outflows will be necessary to control the water quality of the effluent.

Pre- or post-application treatment of waters high in TN or TP to prevent degradation of surface or groundwater.

g. Impact 7

The seventh impact would be the reduction in the water quality of water recovered from surface, subsurface and ground waters.

Discussion: The estimated recovery water (Table V-A-7) contains total dissolved solids (TDS) in concentrations that could degrade the water quality of Site 21.

	Surface Drainage	Groundwater or Subsurface Drainage	
TDS		Forest Pasture, and Crop	Rapid Infiltration
Existing water	51-226	300	-
Recovery water	400-1000	800-2000	450-1100

TDS for the middle Russian River in the northeast corner of Sonoma County ranged from 113-206 ppm (parts per million). The rapid infiltration areas proposed for this area of the Russian River may increase the TDS of the river. Surface and subsurface drainage of the Knight's Valley area will affect water quality in Redwood Creek which empties into Maacama Creek, a tributary to the Russian River.

High TDS (over 1,000 mg/l) is suspected of reducing reproductive capacities in some fish species such as the Centrarchids and Cyprinids (sunfish and carp).

Remedial, Protective and Mitigation Measures: Monitoring of all outflows will be necessary to control the water quality of the effluent. Pre- or post-application treatment may be necessary to prevent degradation of surface or ground waters.

h. Impact 8

The eighth impact would be an increased biostimulant load into surface waters by increasing livestock on pasture areas.

Discussion: Portions of Knight's Valley, Alexander Valley, and the south Healdsburg (Sub-Area 21.3) area are presently used for livestock grazing, especially in Knight's Valley. The application of treated wastewater onto these areas and surrounding brush and forest areas will increase the pasturage available to these animals, because of year-round grass growth.

This would allow more livestock to be grazed on the same amount of land. Livestock produce 6 to 14 times the waste load of humans which would greatly increase the biostimulants (TN and TP) in surface and subsurface drainage. This increase could cause eutrophication problems in streams of the area.

Remedial, Protective and Mitigation Measures: Provide a buffer zone between stream channel and pasture. Keep cattle away from stream (this will not completely solve the problem).

Limit the amount of livestock that can be grazed on a given watershed.

i. Impact 9

The ninth impact would be TDS buildup in soils that receive treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 7 for Site 5 (Section C-6e).

j. Impact 10

The tenth impact would be the loss of recreation opportunity and potential due to a reduction in water quality and in the quantity and quality of vegetation, fish and wildlife in Site 21.

Discussion: The gross recreation potential available to this area was estimated to be 105 million visitor days per year. The Russian River provides kayaking, canoeing, swimming, fishing, boating, etc. (see page E-31). In order to determine how sensitive these uses are to the quality, more study is required.

Remedial, Protective and Mitigation Measures: Monitor watercourses that are receiving recovered wastewater to control and keep the water quality within the objectives of the California Regional Water Quality Control Board for the North Coast Region (see Ref. 14).

Control wastewater quality pre- and post-application to insure acceptable water quality of waters discharged into recreational waterways.

k. Impact 11

The eleventh impact would be the possible increase in heavy metals and organic solvents which may be toxic to fish and wildlife.

Discussion: Heavy metal concentrations in the wastewater could become concentrated in plant and animal tissue; however, pre-application treatment of the wastewater should greatly reduce this likelihood.

The Mericoma Quicksilver Mine is located in the southern Alexander Valley near Jimtown. The mine is located in a proposed rapid infiltration area or pasture area.

The possible increase in mercury in the surface waters from this source could be hazardous to fish and wildlife.

Methylmercury, the biologically toxic form of merçury, is produced under anaerobic conditions and in the presence of organic acids. It accumulates in animal tissue, increasing in concentration as it moves up the food chain. Predator species such as black bass, herons, grebes and man build up the highest concentrations. Infiltration of wastewater through mercury-laden soils may accelerate these processes.

Remedial, Protective and Mitigation Measures: Heavy metal and organic toxicant concentrations in the treated wastewater will be removed to trace amounts.

The status of the Mericoma Quicksilver Mine should be determined.

The area around the mine could be eliminated as a possible wastewater disposal site.

l. Impact 12

The twelfth impact would be the possible increase in wildlife diseases due to the application of wastewater.

Discussion: Coastal deer are afflicted by several parasites and diseases that may be complicated by wastewater application. Refer to (Section D-37b) on wildlife diseases for a complete discussion of each disease.

The lung worm *Parelaphostrongylus odocoilei* infects deer. Its complicated life cycle involves snails and slugs in intermediate hosts for the parasite. Wastewater application could increase the intermediate host by creating a more moist micro-environment suitable for its propagation.

"Stomach" worms are responsible for the greatest loss of deer in California. Three species of stomach worms are several of the more common serious ones: *Oesophagostomum venulosum*, *Ostergagia circumcincta*, and *Nematodirus filicollis*. These parasites have direct transmission, eggs pass in fecal material of deer, hatch, and the larvae crawl on grass blades to be eaten by deer. The application of wastewater will create more pasturage; this could be utilized by deer especially if good quality browse is not available. Any additional use of grass could increase the incidence of stomach worms among deer.

Sheep grazing on pasture may increase exposure of deer to stomach roundworms by increasing the incidence of the parasite. Parasite infection is most common during late winter when the grass is green and

the larvae have a better chance to survive. Continual application of wastewater would create difficulties in controlling the parasite, especially for sheepherders.

Another parasite, the liver fluke (Fasciola hepatica) is common to sheep, cattle and deer but is more serious in sheep. This fluke has a freshwater snail as an intermediate host. Application of wastewater could increase water flows in intermittent streams creating additional habitat for the snail intermediate host. Additional problems would ensue if streams or standing pools of water were in pasture areas readily available to livestock and deer.

A protozoan disease anaplasmosis (Anaplasma marginale) infects deer and cattle. Transmission of the disease is caused by ticks primarily, and secondarily by mosquitoes, horse-flies and other biting insects.

Wastewater application should be conducted in a way to not encourage mosquito breeding.

Remedial, Protective and Mitigation Measures: Initiate control measures that would reduce the number of intermediate host species.

Apply wastewater to pasture areas in quantities small enough to prevent formation of permanent pools of water.

Prevent, whenever possible, accumulation of excess standing water in pastures by pumping or draining out water.

m. Impact 13

The thirteenth impact would be the possible establishment of a fishery in intermittent streams where flows have been increased by drainage of wastewater.

Discussion: If the quality of recovered water is high, fish may immigrate into streams where the water flow has been increased by drainage of wastewater. If the water is cool (68°F or less), fish such as salmonids will use the stream along with warm-water fish species such as Centrarchids (sunfish) and Cyprinids (carp and minnows). Although increasing fish habitat would be beneficial, the additional moisture would create more habitat for intermediate hosts and vectors of some deer parasites and diseases.

Remedial, Protective and Mitigation Measures: The extent to which the increased water would create a higher disease potential by increasing intermediate host or vector species of wildlife would have to be studied and weighed against increasing fish habitat, the latter generally considered to be beneficial. Some fish species may aid in controlling intermediate host or vector species.

n. Impact 14

The fourteenth impact would be a change in scenic recreational value of the area.

Discussion: If the source of water is known, above-ground distribution facilities, spraying heads, and misting heads would be aesthetically displeasing to persons using recreational facilities in Site 21.

The Russian River is a scenic waterway, enjoyed by many persons, especially during the summer months. Private campgrounds found in the area include Camp Maacama, Alexander Valley campground, T-Bird Ranch, and Rancho Los Ojitos. Highway 101 and other surface roads offer scenic views that would be marred by project facilities.

Remedial, Protective and Mitigation Measures: Exclude public and private recreational facilities as wastewater application zones.

Make a buffer strip around wastewater application areas.

Use natural vegetation to hide project facilities whenever possible from highways, recreation areas and private residences.

Plant native vegetative species if on-site vegetation is not adequate.

o. Impact 15

The fifteenth impact would be the effect of wastewater storage reservoirs on the fish and wildlife, vegetation and recreational potential of Site 21.

Discussion: Storage reservoir(s) would be built to impound wastewater for future distribution. The vegetation and wildlife habitat in these locales would be lost. Wildlife would be displaced into surrounding

habitat. If the carrying capacity of adjacent lands were low for that particular species, the displaced animals would probably survive. If the carrying capacity for any species is exceeded on adjacent lands, the numbers of this species will be reduced. The present land use would be lost in areas inundated by wastewater holding reservoirs.

The reservoirs would create a different ecosystem. Animals and plants associated with water edges could occur. Fish could be established if water quality permitted it. Recreation on the reservoirs could exist if water quality met public health standards for bodily contact. (See "Water Growth Criteria".)

<u>Remedial, Protective and Mitigation Measures</u>: The elimination of native flora and fauna and the loss of the land to reservoirs cannot be mitigated.

p. Impact 16

Generation of unpleasant odors.

<u>Discussion, and Remedial, Protective and Mitigation Measures</u>: Refer to the discussion of Impact 21 for Site 5 (Section C-6u).

q. Impact 17

The seventeenth impact would be increased mosquito and midge populations.

<u>Discussion, and Remedial, Protective and Mitigation Measures</u>: Refer to the discussion of Impact 16 for Site 5 (Section C-6p).

r. Impact 18

The eighteenth impact would be the possible increase in stream turbidity caused by increased runoff.

<u>Discussion, and Remedial, Protective and Mitigation Measures</u>: Application of wastewater to Site 21 could increase stream turbidity through several mechanisms. Refer to the discussion of this topic relative to Impact 8 for Site 28 (Section C-6h). Stream turbidity could be an important problem to solve before wastewater could be used to create perennial stream flows in heretofore intermittent streams.

s. Impact 19

The nineteenth impact would be the possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 15 for Site 4 (Section B-6o).

t. Impact 20

The twentieth impact would be the introduction of fish diseases and parasites into new areas by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 4 (Section B-6p).

u. Impact 21

The twenty-first impact would be the increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 17 for Site 4 (Section B-6q).

v. Impact 22

The twenty-second impact would be the increase in stress factors of fish and their relationship to the susceptibility of fish to disease and parasitism.

Discussion: Refer to the discussion of this topic under the long-term impacts for Site 18, Impact 24 (Section D-6x).

w. Impact 23

The twenty-third impact would be the increase in fish diseases because of higher water temperatures of recovered wastewater and increased bacterial growth.

Discussion: Refer to the discussion of this topic under the long-term impacts of Site 18, Impact 25 (Section D-6y).

x. Summary of Sensitive Areas

Figure F-E-1 delineates the location of environmentally "sensitive" areas in Site 21. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

The "sensitive" areas of Site 21 consist of: (1) the Russian River all through the Site Area, (2) Sausal Creek in Sub-Area 21.1, (3) Maacama Creek and its major tributaries, Briggs, Redwood, and Franz Creeks in Sub-Area 21.2, (4) two sections of scenic highway in Sub-Area 21.1, Red Winery Road just north of the Jimtown community center, and US 101 roughly parallel to the Russian River and west of it, and (5) several coniferous, Redwood forest areas; one in the western part of Sub-Area 21.1 just west of Geyserville, and three in Sub-Area 21.2 - one in the vacinity of Mt. Helena at the eastern perimeter - another just west of Knights Valley in the vacinity of the confluence of Redwood Creek with Maacama Creek - and the third along upper Franz Creek and north of Franz Valley.

SECTION F

F. WASTEWATER LAND APPLICATION SITE 27: THE SALINAS VALLEY AREA

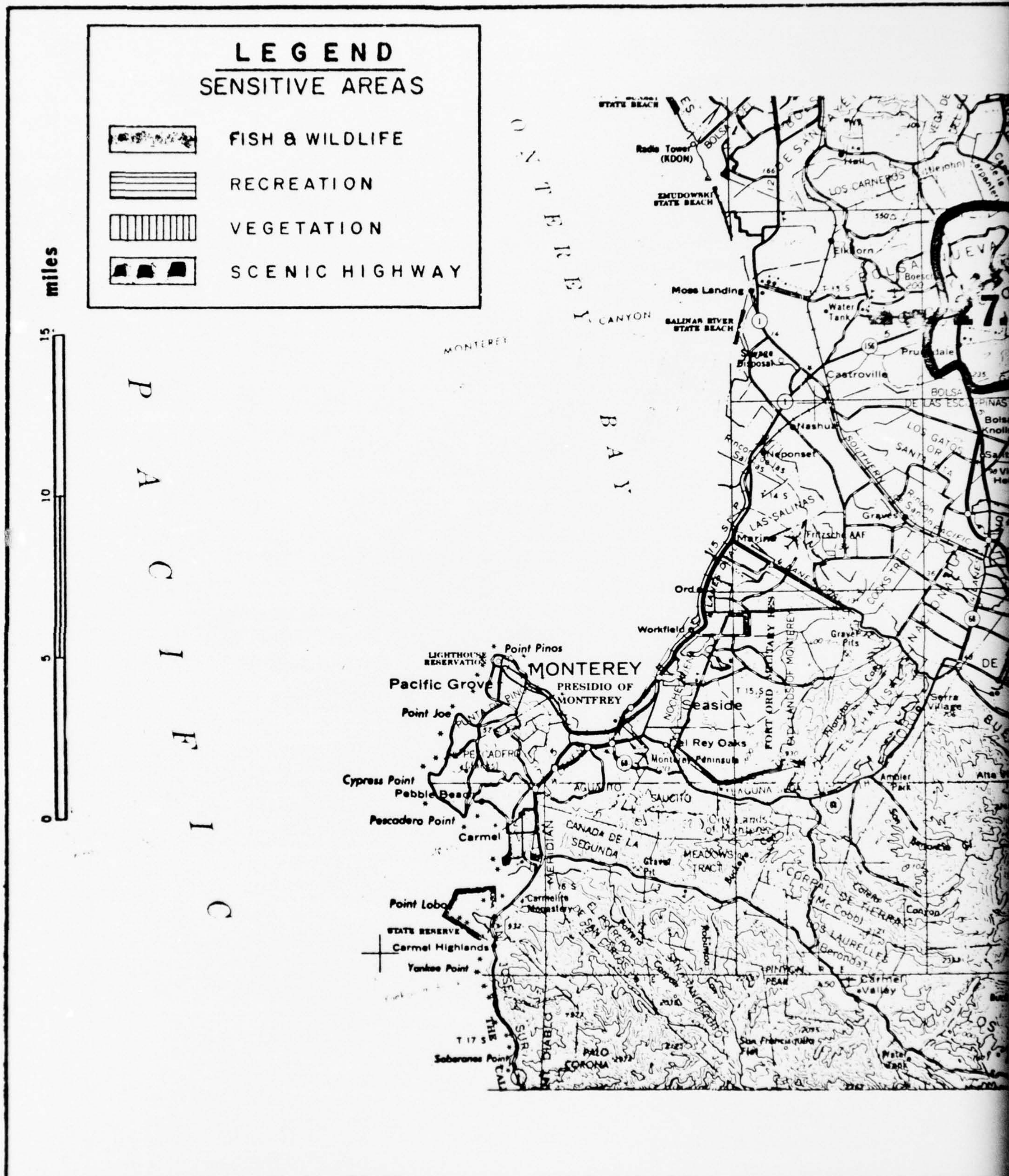
1 - Project Development

a. Present Land Use

Site 27 is located in the northeastern corner of Monterey County and projects slightly into the northwestern corner of San Benito County just South of San Juan Bautista. It lies east of Monterey Bay and generally east of the Salinas River. The City of Salinas and Santa Rita are located about 3 miles west of the central part of the Site's western perimeter. Monterey lies 17 miles to the southwest, Hollister 8 miles to the nortneast, Watsonville and Santa Cruz about 5 and 30 miles respectively to the northwest; Soledad 7 miles to the southeast. Chualar and Gonzales lie within the Site's southwestern edge. Metropolitan San Jose lies about 40 miles to the north. Site 27 includes most of the western slopes and foothills of the Gabilan Mountain Range which drain into the Salinas River from a point roughly north of Gonzales.

The eastern perimeter of Site 27 is provided by the drainage divide of the Gabilan Mountain Range between the San Benito River watershed (Tributary to the Pajaro River) on the east and the Salinas River watershed on the west; the southern two-thirds of this ridge line also being the Monterey-San Benito County line. The northern perimeter is provided by a drainage divide; the Elkhorn Slough watershed lying to the north of it outside Site 27; areas within Site 27 lying south of it and draining into the upper part of the Tembladera Slough drainage. The western perimeter, from north to south, is provided by (1) a low drainage divide between Site 27 areas on the east and areas on the west draining into Elkhorn Slough, the line running about half a mile west of U.S. 101 and Miguel Canyon Road, (2) a tributary channel of Tembladera Slough easterly toward the junction of Herbert and San Juan Grade Roads, (3) Herbert Road, Old Stage Road, William Road, Alisal Road, and Hartnell Road and its southern projection to the Salinas River, and (4) the Salinas River to Gonzales River Road. The southern perimeter, from west to east, is provided by (1) Gonzales River Road, (2) Gloria Road, (3) McCoy Creek, and (4) a creek along Shadey Lane Canyon easterly to its headwaters area and the drainage divide of the Gabilan Mountain Range. Use Figures V-G-1 and V-G-2 for location reference.

Site 27 occupies about 141,400 acres. For study purposes, it has been divided into five sub-areas as shown in Figures V-F-1 and 2. These



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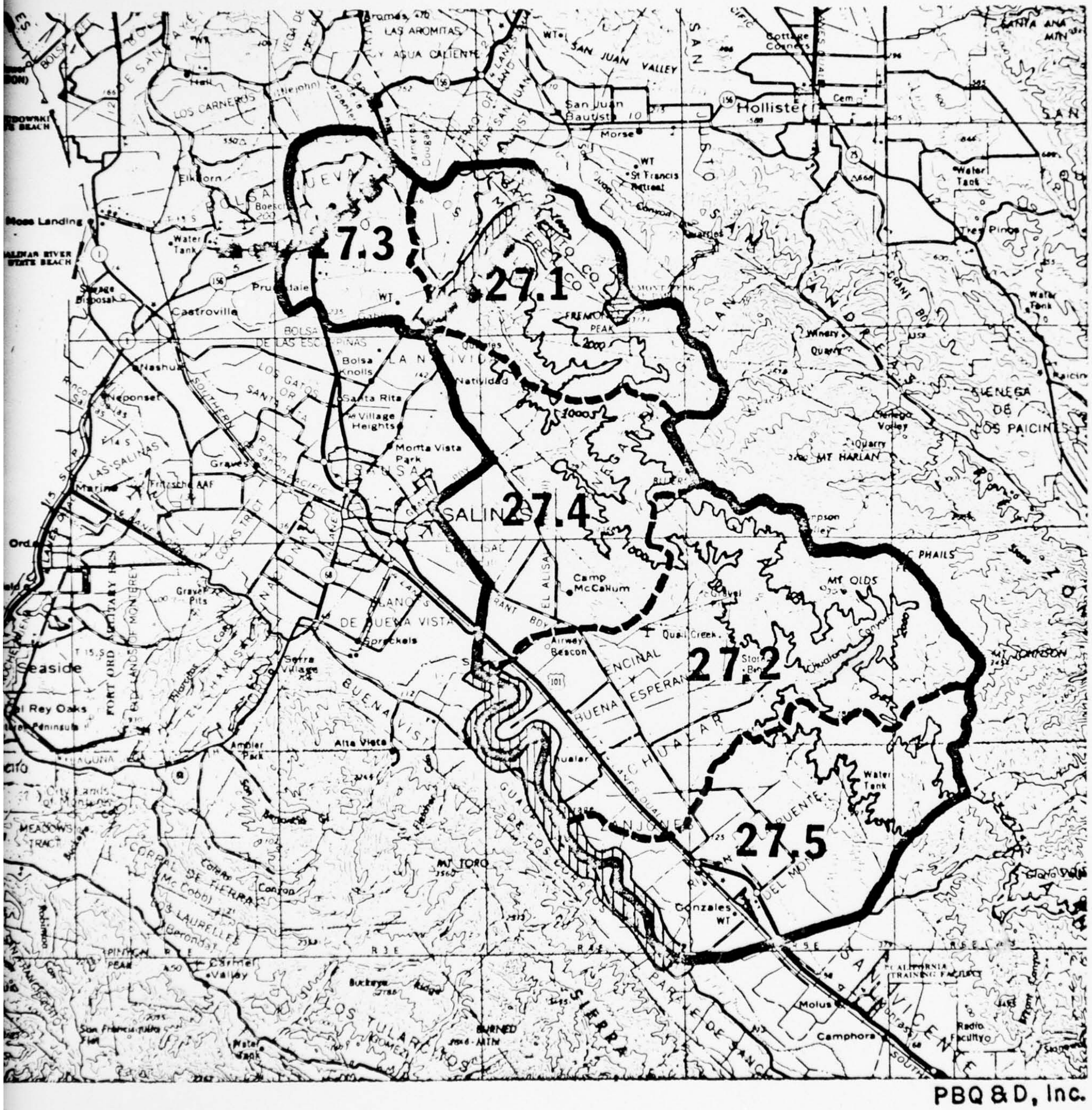

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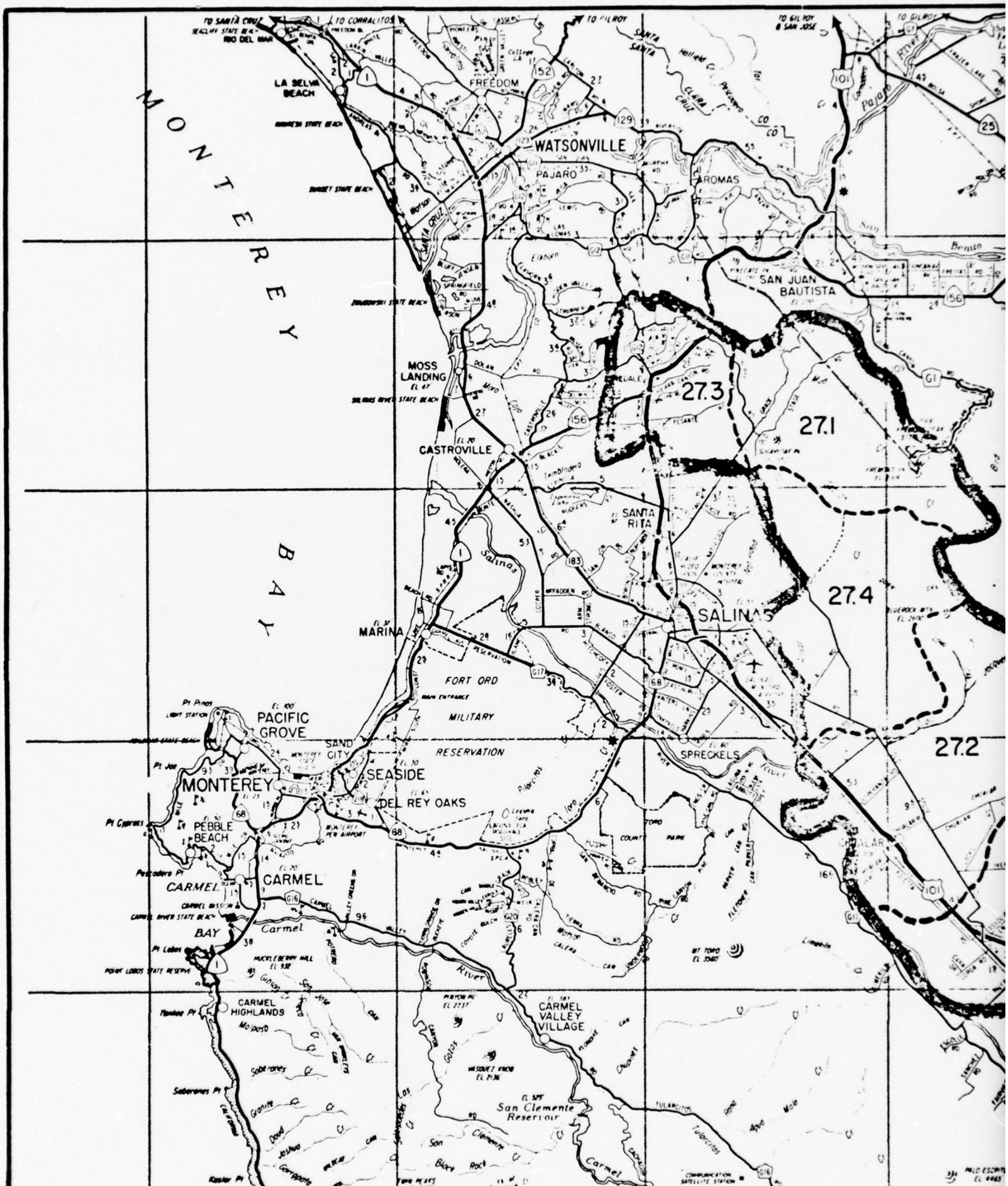

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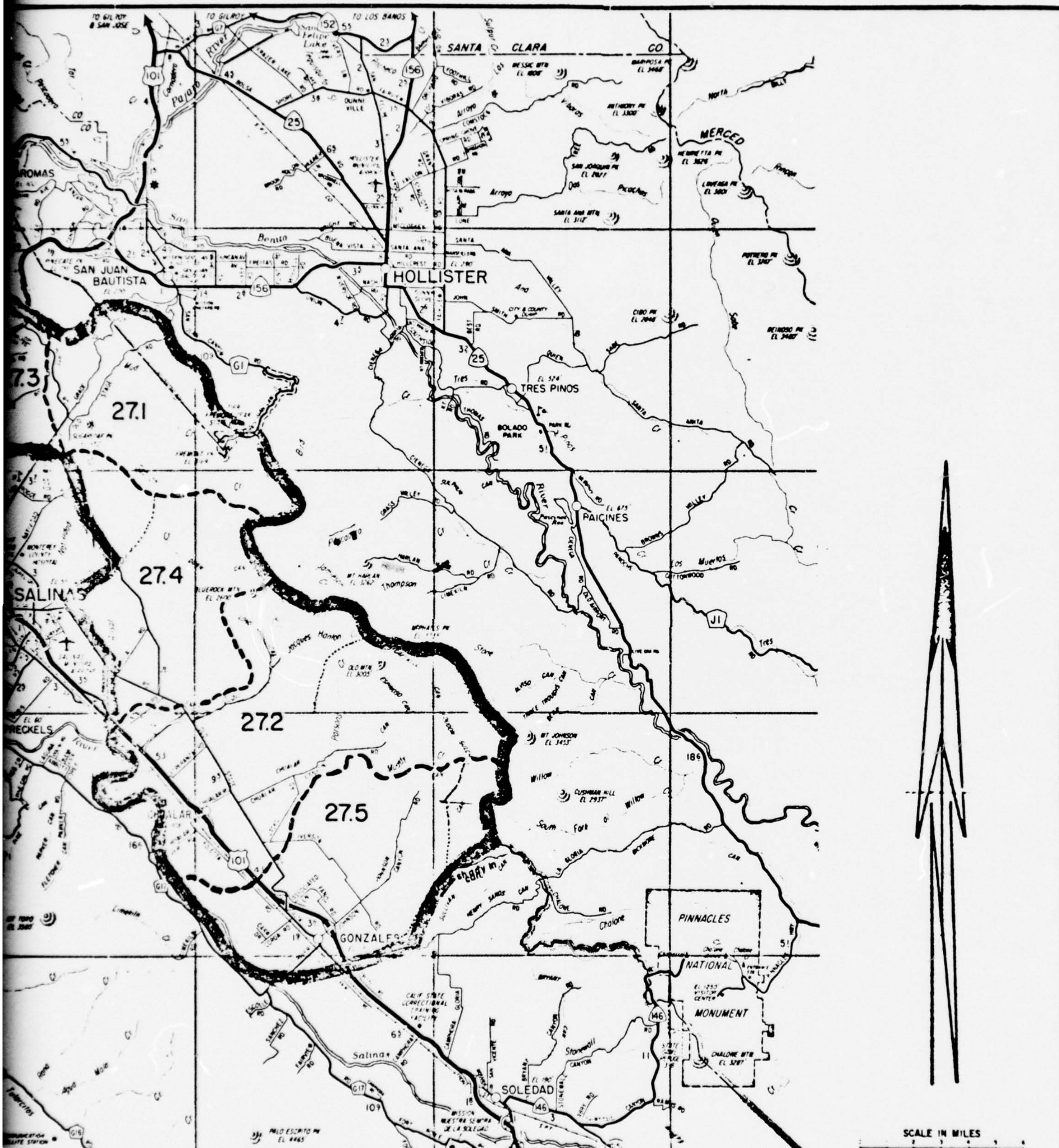
2


TO GILROY
TO LOS BANOS
SANTA CLARA CO
MERCED
HOLLISTER
SAN JUAN BAUTISTA
TRES PINOS
BOLADO PARK
PAICINES
SALINAS
GONZALES
SOLEDAD
PINNACLES
NATIONAL
MONUMENT
27.1
27.2
27.3
27.4
27.5
SCALE IN MILES

sub-areas and their areas are as follows:

Sub-Area No.	Sub-Area Designation	Area in Acres
27.1	Gabilan Creek	23,300
27.2	Quail and Chualar Creeks	47,700
27.3	Tembladera Creek-Prunedale	10,400
27.4	Natividad and Alisal Creeks	28,900
27.5	Johnson Creek-Gonzales	31,100

Agriculture is the most extensive land-use in Site 27. It dominates about two-thirds of the Site, all of the Salinas Valley flatlands and most of the foothills, intermountain finger valley bottomlands, and the lower slopes of the Site's hills and small mountains. Irrigated crop cultivation, sugar beets and truck and table vegetable crops, tend to prevail in the flatlands closest to the Salinas River while dairy and beef pasturage are prevalent in the upper flatlands, narrow valleys and lower hill and small mountain slopes. Several large feed lot operations are located in Sub-Areas 27.2 and 27.5 while several greenhouse operations are scattered in Sub-Areas 27.2 and 27.4. There is also a small amount of dry cereal farming and sheep pasturing in the canyon bottomlands of Sub-Areas 27.1 and 27.4, and the beginnings of significant irrigated grape cultivation or vineyards in the upper flatlands of Sub-Areas 27.2 and 27.5. A few orchards occur in sites located in canyon bottomlands and upper Salinas Valley flatlands.

Open lands are the next most extensive land-use and consist of chaparral and hardwoods which occupy the higher elevations of the Site. Site 27 has a moderately extensive system of roads, particularly in the western flatlands. The most important of these is the freeway, U.S. 101. Residential land-use and spotty urban-commercial development is scattered extensively all along these roadways and is concentrated around the communities of Chualar (Sub-Area 27.2), Gonzales (Sub-Area 27.5), and all through the Prunedale area of western Sub-Area 27.3, generally in those areas closest to Salinas. Residential development throughout the Prunedale area is predominantly of the semi-suburban-to-exurban type, generally middle and lower income in quality and style together with significant amounts being almost rural-slum in condition. Roadside commercial development in this area is indiscriminate and of comparable quality, complete with junkyards and a proliferation of gas stations. One significant industrial land-use exists, the quarry operation of Kaiser Refractories just east of Old Stage Road in the northernmost tip of Sub-Area 27.4. This operation has resulted in extensive excavations into the 700-to-900 foot high hills in the immediate vicinity. Recreational and associated land-uses are rather limited. The significant recreational facility is the Fremont Peak

State Park located astride the major eastern perimeter divide of Sub-Area 27.1 in the headwaters area of Mud Creek (the major tributary of Gabilan Creek).

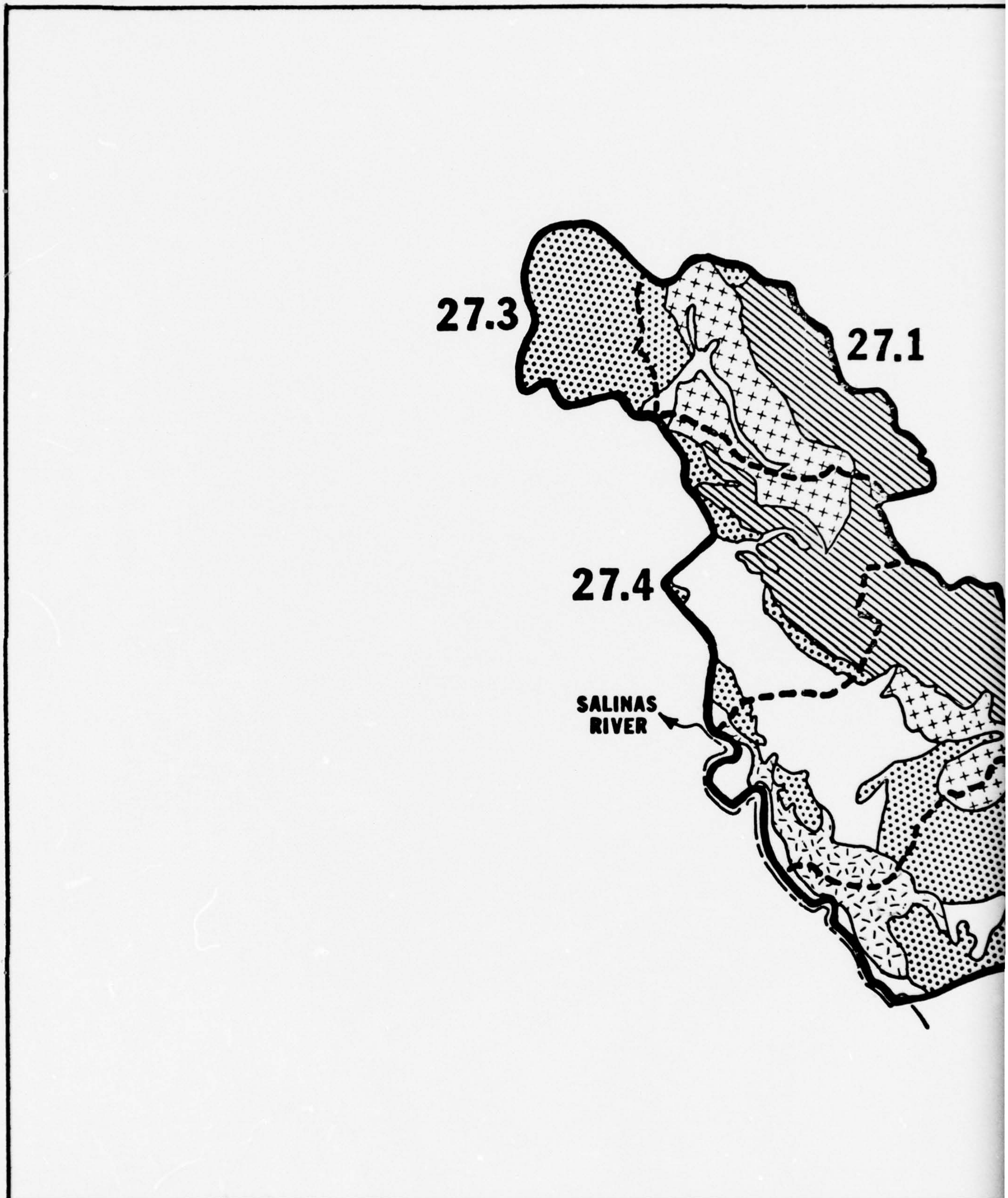
Relative to future development, the U.S. Bureau of Reclamation's plans for their San Felipe Project include diversion of irrigation water supplies from the Central Valley to the northern part of Site 27. The Corps of Engineers is also currently doing a flood control study of the Salinas River Valley which may result in some proposed new works. Flows in the lower river area may be affected. Some areas along the river edge in Sub-Area 27.5 are currently subject to flooding during heavy winter storms.

b. Development Objectives

Site 27 is considered representative of a number of potential land application sites located in the interior of the Coast Range. Site 27 offers a potential for managed forests (particularly Monterey pine) for irrigated crops on the valley floor and for irrigated pasturage on the upper valley slopes. The application of wastewater for irrigated crop cultivation and pasture enhancement could continue this type of agricultural land-use and at the same time provide an opportunity for diminishing or reversing the salt water intrusion into the Site Area and its environs caused by excessive pumping for irrigation water supplies.

The point was made in sub-section F-1a that plans for the San Felipe Project by the U.S. Bureau of Reclamation include diversion of irrigation water supplies from the Central Valley to the northern part of the Site Area. Many of the present crops (i.e., lettuce, broccoli, table grapes) being irrigated could not use most secondary-level treated wastewater supplies because they are table vegetable type crops and such wastewater probably do not meet applicable public health standards. However, the possibility exists for shifting to other types of crop (i.e., sugar beets, cereals) that could be irrigated with treated wastewater or upgrading the degree of pretreatment so applied wastewater will meet appropriate standards.

Proposed land uses and types of land application based on soil capabilities are shown in Figure V-F-3. This figure and Figure V-F-4 also show areas which were considered to be excluded because of excessive elevation (over 1500 feet). Areas with slopes over 30 percent predominating have been delineated in Figure V-F-4. These slopes may be too steep and are being considered for exclusion because of erosion enhancement and possible landslide conditions. These areas have been delineated by means of on-site inspection and topographic map analysis. Recommended unit



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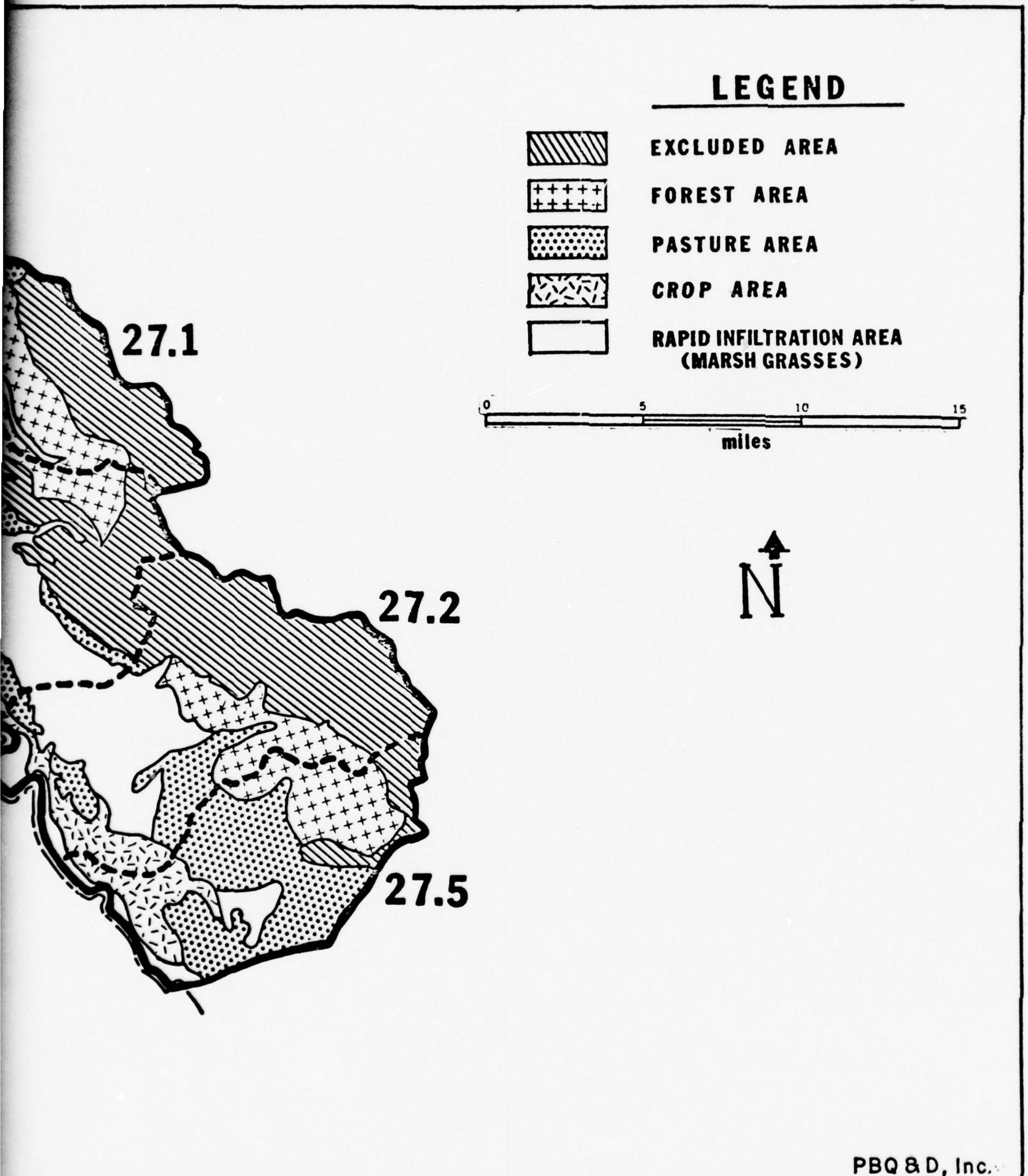

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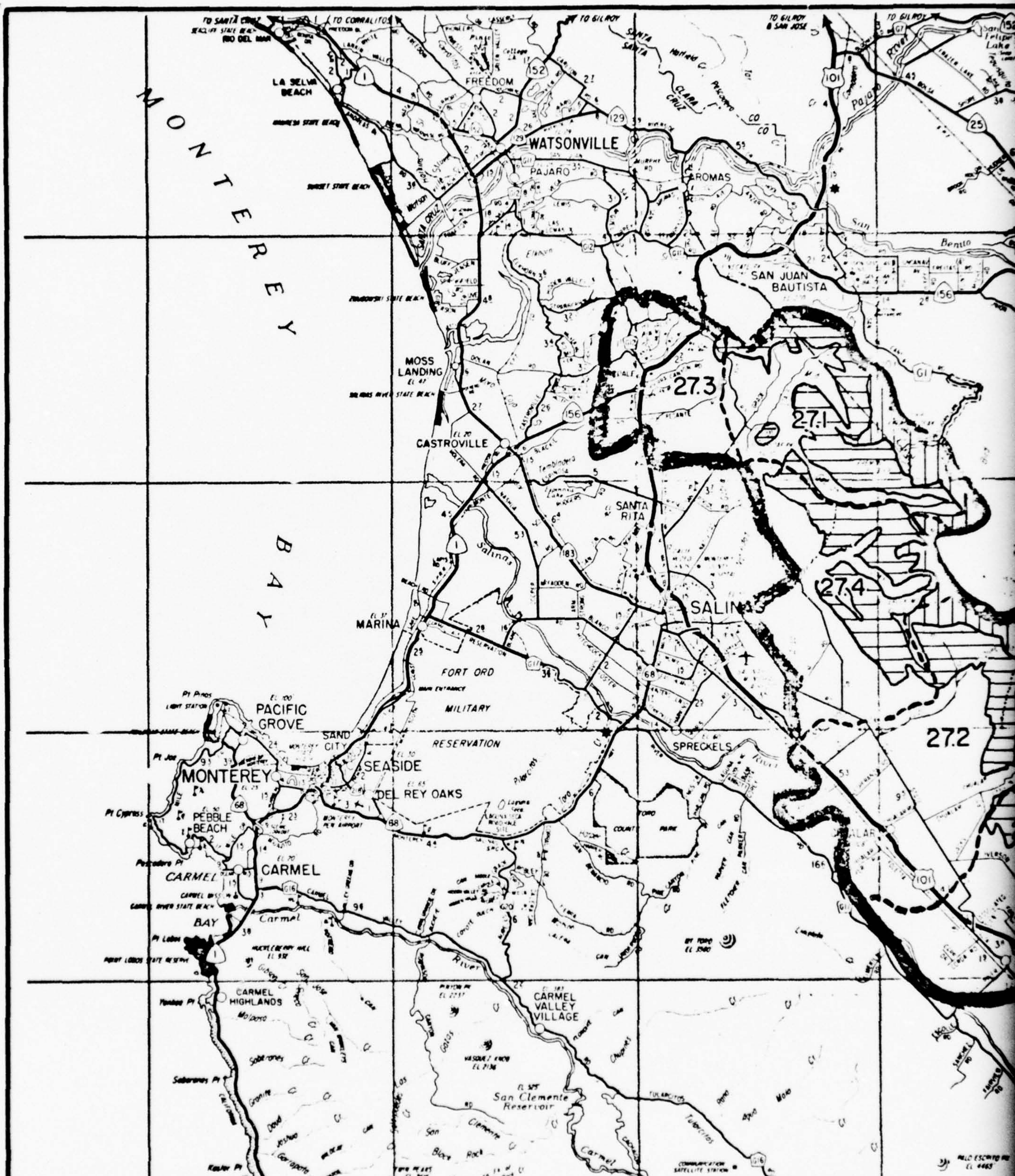

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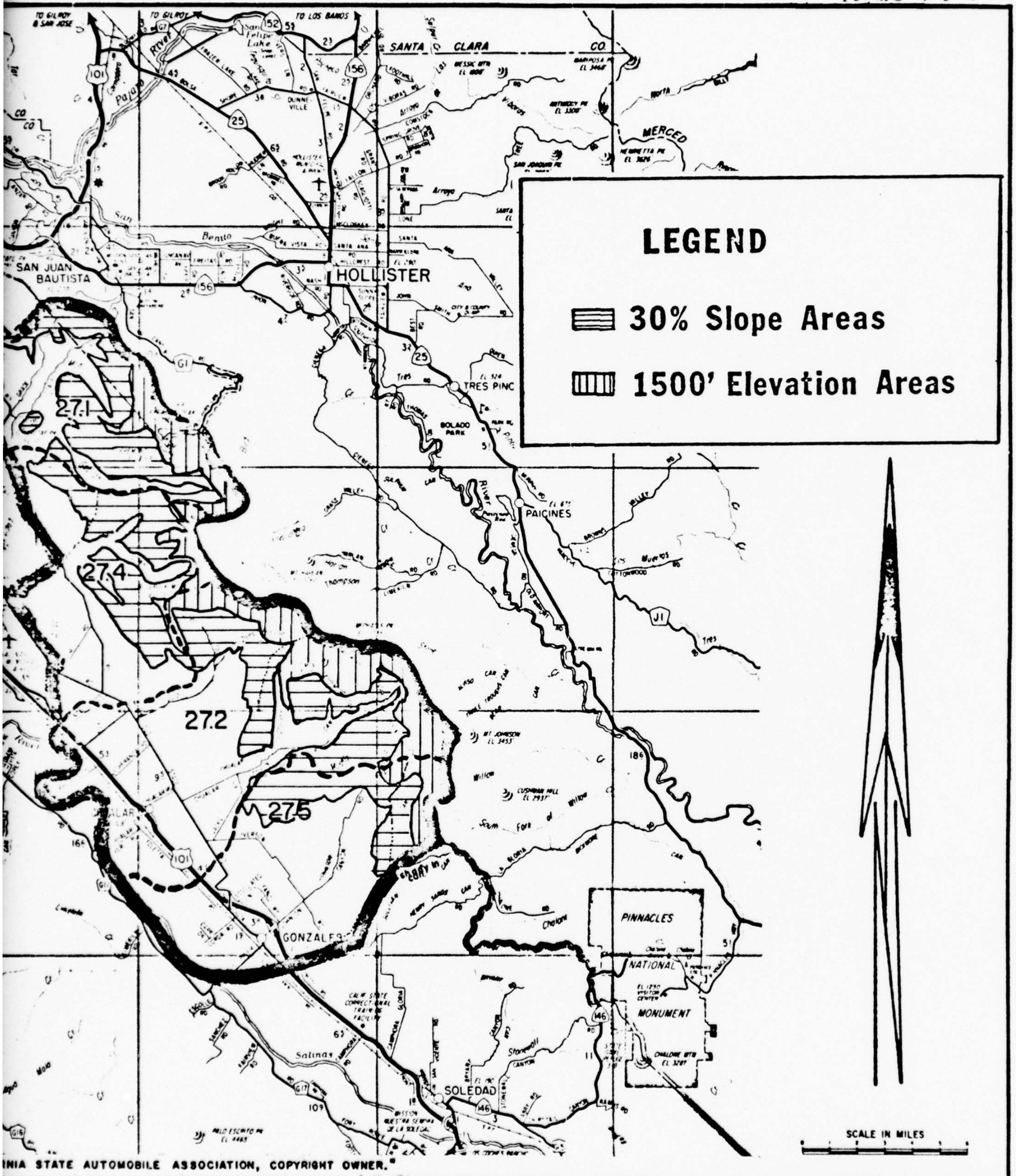
Figure V-F-4


LEGEND
30% Slope Areas
1500' Elevation Areas
SCALE IN MILES
TO GILROY & SAN JOSE
TO GILROY
TO LOS BANOS
SANTA CLARA CO.
MERCED
San Felipe Lake
Pajaro River
DUNNE VILLE
SAN JUAN BAUTISTA
HOLLISTER
San Benito
TRES PINOS
BOLADO PARK
PAICINES
27.1
27.4
27.2
27.5
PINNACLES NATIONAL MONUMENT
GONZALES
SOLEDAD
Salinas
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application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10.

The possible sources of wastewater for land application to parcels in Site 27 and the possible specific combinations of them will depend upon the degree and extensiveness of the regionalization in the collection and treatment of wastewaters thought advisable. The possible sources include, the Monterey Bay area communities, metropolitan San Jose, other communities from the Santa Clara Valley, and most of the San Francisco Bay fronting communities of southern Alameda County such as Fremont, Newark, Union City, Hayward, and San Leandro. These treated wastewaters can best be brought into the Site Area along a few of the major and minor roadways that enter the Site Area, principally U.S. 101. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible wastewater sources indicated above. The estimated quality of recoverable wastewaters is that presented in Table V-A-7.

The distribution and recovery systems will follow the management and development outlines presented in Section A-7a, b, and c. The general conveyance of wastewaters into Site 27 is uphill considering the elevations of the major source areas. It is therefore expected that the distribution system will be designed, at least in part, much like that of any water supply distribution system complete with pressure zones to minimize pumping costs. Conveyance of wastewaters to Site 27 from the closest areas within the San Francisco Bay-Delta waste source region has to surmount some significant increases in elevation enroute. The most direct route from the Bay-Delta waste source region, particularly from metropolitan San Jose, is along the bottom of the Santa Clara Valley, i.e., at or near U.S. 101. The highest elevation encountered enroute is about 350 feet at Morgan Hill. The Santa Clara Valley north of Morgan Hill drains into South San Francisco Bay; south of Morgan Hill it drains into Monterey Bay through the Pajaro River. The most direct route from Morgan Hill to the Site Area is along U.S.101; the lowest entry elevation is 458 feet at the northern perimeter of Sub-Area 27.3, and subsequently about 540 feet at a high point along Crazy Horse Road for the most direct entry into Sub-Area 27.1, the other more southern sub-areas being easily accessible from there since the Salinas Valley flatlands of these southern sub-areas are under 400 feet of elevation. The 540 foot Crazy Horse Road 'hurdle' can be avoided by a western 'swing' along U.S. 101; this leaving the 458 foot elevation point the high point of entry. This high point of entry can be further reduced by other "end-run swings" to the west, but at the price of increasing pipeline length. Lower "gaps" are found along the northern perimeter of Sub-Area 27.3 west of U.S. 101 at Maher Road (about 430 feet) and Miguel Canyon Road (about

385 feet). The only way this entry elevation can be further reduced would be by a very large "swing" around the northern end of the Gabilan Mountain Range generally in or along the floodplain of Elkhorn Slough. The lowest "gaps" along the northern and northwestern perimeter of Site 27 east of U.S.101 (and involving somewhat more direct routing from Morgan Hill to Sub-Areas 27.1, 27.4, 27.2, and 27.5) are at elevations of 732 feet (just east of U.S. 101 and about due north of Sugarloaf Peak, in Sub-Area 27.1) and about 1010 feet (where San Juan Grade Road crosses the eastern perimeter of Sub-Area 27.1). From the foregoing analysis, it is clear what varying portions of the Salinas Valley flatlands could be served by a gravity system once the various elevation hurdles had been overcome.

The location of conveyance of pumping facilities in the more mountainous portion of Site 27 will require substantial analysis of flow and pumping requirements in relation to natural topography. In the areas of much less pronounced relief, conveyance and pumping facilities could be located in alignments unrestricted by topography. It is expected that major distribution lines will be located along the major and minor roadways with laterals peeling off at selected elevations. Laterals in the western continuous flatlands can follow the pattern of the existing road system and/or tie into the already existing irrigation works. Laterals will project into the intermountain finger valleys in the general pattern discussed in Section A-7c for the Capay Valley. Significant areas for land application exist in all sub-areas of Site 27. Proposed rapid infiltration areas are found in all sub-areas, but are concentrated in Sub-Areas 27.2 and 27.4. Proposed crop cultivation areas are concentrated in Sub-Areas 27.2 and 27.5 while proposed irrigated pasture lands (found in all sub-areas) are concentrated in Sub-Areas 27.3 and 27.5.

The recovery of applied wastewaters through sub-surface systems will be confined to those areas proposed for rapid infiltration and crop cultivation and probably through existing drainage facilities. The pasture and forest lands can, for recovery purposes, use small constructed catchments or impoundments on the many small tributary channels which drain these areas together with pumping facilities to convey away such waters as may require post-treatment or which can be directly re-used.

Site 27, like Sites 18, 21, and 28, lies wholly within the Coast Range geomorphic province, and specifically, like Site 21, wholly within the inner or interior portions of the range. The Site is confined to the east side of the northernmost and lowest section of the Salinas Valley and the western slopes of the northernmost elements of the Gabilan Mountain Range, an inner coast range which provides most of the east "wall" of the Salinas Valley and separates it from the southern part of the Santa Clara Valley and the upper watershed of the San Benito River which lies to the east. Elevations range from a low of about 10 feet (where Tembladera Slough enters Sub-Area 27.3 at its southwest corner) to 3,417 feet at a peak just southwest of Mt. Johnson (just about at the common southeast corner of Sub-Area 27.2 and the northeast corner of Sub-Area 27.5). The second highest peak is McPhails Peak at 3,353 feet (Sub-Area 27.2); the third highest is Fremont Peak at 3,171 feet (Sub-Area 27.1).

The Site's two characteristic and generalized physiographic regions are (1) the low rolling hills and small open and somewhat rugged mountain highlands, ranging in elevation from 300 to 400 feet on up, and covered predominantly with grasses, chaparral, and some oakwood timber stands, and (2) the intermountain valley lowlands, generally ranging in elevation between 50 to 90 feet up to 300 and 400 feet. The intermountain valley lowlands consist primarily of the floodplain and continuous alluvial fans of the Salinas Valley, which is more mature and more U-shaped, together with the many small more youthful and V-shaped stream valley floodplains which penetrate into the hilly and mountainous Gabilan Range area. The Salinas Valley is about 93 miles long and about 7 miles wide in the vicinity of Site 27. It is the largest intermountain valley in the Coast Range geomorphic province. The Salinas Valley lowlands within Sub-Areas 27.4, 27.2, and 27.5 vary in width from about 2 to about 6 miles. The Site Area is 20 to 50 percent gently sloping with over 75 percent of the gentle slopes being in the lowlands, this being a characteristic of most of the Coast Range from Santa Barbara County north to the lower portions of the Russian River watershed. Figure V-F-5 shows some typical views of the Site Area.

a. Geology and Hydrology

Summary of Geology: The oldest major subsurface stratum in Site 27 and the most extensive is composed of igneous and meta-igneous

1. S Down Gabilan Range on San Juan Grade Road About 3 Miles NNE from Intersection of Horse Road

2. Same as #1 Photo.

4. WSW View Across Salinas River Showing the Santa Lucia Range, Riparian Habitat of the Salinas River from about 1 Mile SW Down Somavia Road from Highway 101 Intersection

5. SE View of Salinas Valley fro
Same Location as #4

Site 27

Same as #1 Photo.

3. SE Down Gabilan Range on San Juan Grade Road about 3-1/2 miles NNE from Intersection of Horse Road

. SE View of Salinas Valley from Same Location as #4

6. View Up San Juan Canyon Road in Fremont Peak State Park

rocks of Mesozoic age (60 to 185 million years old, perhaps older), specifically Mesozoic granitic rocks consisting of Santa Lucia quartz diorite, granite, quartz monzonite, and minor amounts of gneiss. This stratum underlies almost all of the upland areas of Site 27 with the exception of Sub-Area 27.3. It includes scattered minor pockets of somewhat older Pre-Cretaceaous metamorphic rock strata (early Mesozoic to late Paleozoic, 130 to perhaps 210 million years old) consisting of (1) Gabilan limestone and dolomite (and perhaps lenses of marble with quartzite and schist) at such locations as Sugarloaf and Fremont Peaks in Sub-Area 27.1, Bluerock Mountain and the Kaiser Refractories quarry (discussed in section G-1a) in Sub-Area 27.4, and Old Mountain in Sub-Area 27.2; and (2) crystalline or marble schist, quartzite, gneiss, with minor amounts of granite at such locations as McPhails Peak in Sub-Area 27.2.

The remainder of Site 27 is underlain with younger (Quaternary) Cenozoic non-marine sedimentary and meta-sedimentary rock strata (under one million years old). Pleistocene non-marine sedimentary deposits of Aromas red sands, Dos Pichachos gravels, Peckham formation materials, and older alluvium (one-half to one million years old) underlie almost all of Sub-Area 27.3 and some small low foothill areas in Sub-Areas 27.2 and 27.5, one just north of Chualar Creek, two north of Johnson Creek, and one between Johnson and McCoy Creeks. Quaternary non-marine river and stream terrace deposits (terrace gravels and alluvial fan deposit materials) are located generally in the upper elevation zone of the Salinas Valley lowlands; more specifically, in a narrow band along the southern perimeter of Sub-Area 27.3 and projecting up the valley of Gabilan and Muddy Creeks in Sub-Area 27.1; in almost all the lowlands of Sub-Area 27.4 north of Alisal Road; in over half of the lowlands of Sub-Area 27.2 north of Old Stage Road; and in almost all the lowlands of Sub-Area 27.5 north of Old Stage Road and US 101. Recent alluvium (under 0.5 million years old) consisting of stream gravels and alluvial sands are generally located in the lower elevations of the Salinas Valley lowlands and in the floodplains of the tributary stream channels; more specifically in Site 27 they are located in a narrow band all along the western perimeter of Sub-Area 27.5, 27.2, and 27.4 extending easterly broadly beyond Alisal Road partway up Alisal Creek in Sub-Area 27.4, up to Old Stage Road generally and all along the floodplain of Chualar Creek and up Chualar Canyon specifically in Sub-Area 27.2, and just beyond Old Stage Road and US 101 in Sub-Area 27.5; this stratum also projects up the floodplain of lower Gabilan Creek just past its confluence with its tributary, Muddy Creek (in Sub-Area 27.1), and also projects up the floodplain of Tembladera Slough into a small area in the southwest corner of Sub-Area 27.3 just east of US 101.

Site 27 itself contains no significant fault lines within its perimeters. The important San Andreas Fault Zone is, however, located east of the Site Area's eastern perimeter in the foothills of the Gabilan Mountain Range's eastern slopes together with branch fault lines located just beyond the Site Area's northern and northeastern perimeters. Some small fault lines also lie west of the Salinas River in the foothills and lower elevations of the Sierra de Salinas. (Background reference Section A-3b, Refs. 2, 9.)

Summary of Hydrologic Systems and Water Quality Conditions: Site 27 is an area composed entirely of lands located within the Salinas River watershed. The Salinas River itself is about 155 miles long and is the major tributary of Monterey Bay. It reportedly is the largest submerged river in the country (Ref. 10k). The Salinas Valley groundwater basin underlies all the valley lowlands and is contiguous with the groundwater basins of Elkhorn Slough and the lower Pajaro River so as to form one large ground water basin east of Monterey Bay. This groundwater basin underlies almost all of Sub-Area 27.3 and a broad western band under the other sub-areas.

The five sub-areas of Site 27 fairly closely correspond to the major tributary drainage basins of the Salinas River within its perimeter. Sub-Area 27.3 consists of all lands draining into Tembladera Slough within the Site Area. Tembladera Slough itself drains into Old Salinas River, a channel connecting the mouth of the Salinas River channel proper with the mouth of Elkhorn Slough at Moss Landing. Sub-Area 27.1 consists of the watershed of Gabilan Creek above Herbert and Old Stage Roads. Gabilan Creek drains into Alisal Slough which in turn is technically tributary to both Tembladera Slough west of Castroville and the Salinas River southwest of Castroville. Gabilan Creek's main tributary is Muddy Creek. Sub-Area 27.4 consists of two principal Salinas River tributary channels, Natividad Creek to the north and the larger Alisal Slough to the south. Both of these, if surface waters were allowed to flow, would enter the Salinas River through Alisal Slough which passes through the City of Salinas. Sub-Area 27.2 also consists of two principal tributary channels, Quail Creek to the north and the larger Chualar Creek to the south. Sub-Area 27.5 consists primarily of the Johnson Creek watershed together with the watershed of McCoy Creek above Gloria Road.

Estimated water quality conditions for the surface and ground waters of Site 27 are presented in Table V-F-1 (Refs. 6, 7, 18, 140). The predominant ions in the surface waters are reportedly (Ref. 6) calcium, magnesium, and bicarbonate. Recent monitoring, however indicates that these predominant ions now include sodium, chloride, and sulfate as a result of irrigated agricultural operations. Both surface and ground waters

Table V-F-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 27

Water Quality Characteristics	Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Total Dissolved Solids:		292-1240 mg/l	Variable
General Area (@ low flows)	700-1180 mg/l 4/		
Salinas Reclam. Canal near Airport			no numerical standards
Salinas R. near Gonzales	50-850		500 mg/l rec. max
Salinas R. near Sprecklės	575-880 2/		500 mg/l rec. max
Salinas R., Alisal and Gabilan Creeks			
--generally good to excellent			under 700 mg/l
--generally good to selectively injurious			700-2000 mg/l
--gen. injurious to unsatis.			over 2000 mg/l
Electro-conductivity: (in micromhos)		466-2030	Variable
Salinas Reclam. Canal at Airport	850-1600		nns
Salinas R. near Gonzales	70-1200		
% time under 1000	94%		
% time under 500	51%		
Salinas R. near Spreckles	509-1860 2/		nns
Tembladero Sl. @ Nashua Rd.	1750-2430		nns
Chualar Creek @ Old Stage	about 430		500 max. mo.* 300 avg. annual*
Quail Creek			600 max. mo.* 400 avg. annual*
Natividad Creek			700 max. mo.* 600 avg. annual*
Gabilan Creek			600 max. mo.* 500 avg. annual*
Salinas R. & Alisal Creek, for irrigation uses			
--generally good to excellent			under 1000
--gen. good to selectively injurious			1000-3000
--gen. injurious to unsatis.			over 3000

Table V-F-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 27

Water Quality Characteristics	Surface Waters[1]	Ground Waters[2]	Current Standards[3]
Total Hardness:		100-658 mg/l	nns
Salinas Recl. Canal @ Airport	250-500 mg/l		nns
Salinas R. near Gonzales	131-438		nns
Salinas R. near Spreckles	213-576[2]		nns
Tembladero Sl. @ Nashua Rd.	500-570		nns
Chualar Cr. @ Old Stage Rd.	about 130		nns
Total Non-CO_3 Hardness:		5-461 mg/l	nns
Salinas Recl. Canal @ Airport	75-210 mg/l		nns
Salinas R. near Gonzales	up to 208		nns
Salinas R. near Spreckles	0-99[2]		nns
Tembladero Sl. @ Nashua Rd.	160-250		nns
NO_3-Nitrogen (as nitrogen)		0.7-17 mg/l	10 mg/l max.(muni
Salinas Recl. Canal @ Airport	16-21 mg/l		?
Salinas R. near Gonzales	about 1.3		10 mg/l max.
Salinas R. near Spreckles	2.0-8.5		10 mg/l max.
Tembladero Sl. @ Nashua Rd.	0.01-9.9		nns
Total Phosphorous:			
Salinas Recl. C. @ Airport	1.5-2.2 mg/l		nns
Salinas R. near Spreckles	2.4-4.0[2]		nns
Tembladero Sl. @ Nashua Rd.	1.3-1.6		nns
pH:		6.4-8.3	7.0-8.5
Salinas Recl.C. @ Airport	7.3-8.6		7.0-8.5
Salinas R. near Gonzales	7.9-8.7		7.0-8.5
Salinas R. near Spreckles	7.2-8.7[2]		7.0-8.5
Tembladero Sl.@ Nashua Rd.	8.2-8.4		7.0-8.5
Chualar Cr.@ Old Stage Rd.	about 7.7		7.0-8.5
Temperature:		65-70°F	nns
General Area median values	60-64°F[4]		
Salinas Recl.C. @ Airport	66-71°F		nns
Salinas R. near Gonzales	43-70°F		nns
Tembladero Sl.@ Nashua Rd.	about 67°F		nns

Table V-F-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 27

Water Quality Characteristics	Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Dissolved Oxygen:			
Salinas Recl.C @ Airport	6-19 mg/l		nns
Salinas R. near Gonzales	9.2-12.2		5.0 mg/l min.
Salinas R. near Spreckles	--		5.0 mg/l min.
Tembladero Sl.@ Nashua Rd.	13-14 mg/l		nns
Alisal & Gabilan Creeks	--		5.0 mg/l min.
Biochemical Oxygen Demand:			
Salinas Recl.C. @ Airport	3-21 mg/l		nns
Salinas R. near Spreckles	7.3-9.2		nns
Tembladero Sl.@ Nashua Rd.	10-12		nns
Bacteria: (colliform organisms)			
Salinas R., Alisal & Gabilan	--		1000/100 ml max.
Turbidity:			
Salinas R.			5 JTU rec. max.
Sediments: (suspended)			
General Area values	280-1950 ppm 4/		nns
Detergents: (as MBAS)			
Salinas Recl.C. @ Airport	0 mg/l		nns
Salinas R. near Spreckles	0-0.1		0.5 mg/l rec. max.
Tembladero Sl.@ Nashua Rd.	0		nns
Ca:		17-154 mg/l	nns
Salinas Recl.C. @ Airport	68-125 mg/l		nns
Salinas R. near Gonzales	about 99		nns
Salinas R. near Spreckles	83-131 2/		nns
Tembladero Sl.@ Nashua Rd.	94-343		nns
Mg:		14-66 mg/l	nns
Salinas Recl.C. @ Airport	27-45 mg/l		nns
Salinas R. near Gonzales	about 44		nns
Salinas R. near Spreckles	22-45 2/		nns
Tembladero Sl.@ Nashua Rd.	64-69		nns
Na:		39-149 mg/l	variable
Salinas Recl.C. @ Airport	80-115 mg/l		nns
Salinas R. near Gonzales	22-102		(see below)
Salinas R. near Spreckles	54-136 2/		(see below)
Tembladero Sl.@ Nashua Rd.	175-352		nns
Chualar Cr.@ Old Stage Rd. (and Gabilan Creek)	about 37		(30% of base constituents, max.mo. 20% of bc, avg.ann.) *

Table V-F-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 27

Water Quality Characteristics	Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Na: (continued)			
Quail & Natividad Creeks	--		40% of bc, max.mo.* 30% of bc, avg.ann.*
Salinas R., Alisal & Gabilan Crs. irrigation uses:			
--generally good to excellent			under 60% of bc
--gen. good to selectively injurious			60-75% of bc
--gen.injurious to unsatis.			over 75% of bc
K:		1.4-4.8 mg/l	nns
Salinas R. near Gonzales	about 4.4 mg/l		nns
Salinas R. near Sprecklès	22-23 2/		nns
CO_3:		0 mg/l	nns
Salinas Recl.C. @ Airport	0 mg/l		nns
Salinas R. near Gonzales	0-16		nns
Salinas R. near Spreckles	0-49 2/		nns
Chualar Cr.@ Old Stage Rd.	0		nns
HCO_3:		73-269 mg/l	nns
Salinas Recl.C. @ Airport	218-354 mg/l		nns
Salinas R. near Gonzales	123-236		nns
Salinas R. near Spreckles	186-792 2/		nns
Tembladero Sl.@ Nashua Rd.	388-410		nns
Chualar Cr.@ Old Stage Rd.	about 118		nns
SO_4:		8.2-173 mg/l	250 mg/l rec.max.
Salinas R. near Gonzales	about 317 mg/l		250 mg/l rec.max.
Salinas R. near Spreckles	51-69 2/		250 mg/l rec.max.
Salinas R., Alisal & Gabilan	--		250 mg/l rec.max.
Cl:		45-406 mg/l	variable
Salinas Recl.C. @ Airport	123-270 mg/l		nns
Salinas R. near Gonzales	15-76		250 mg/l rec.max.
Salinas R. near Spreckles	23-162 2/		250 mg/l rec.max.
Tembladero Sl.@ Nashua Rd.	265-472		nns
Chualar Cr.@ Old Stage Rd.	about 50		nns
Salinas R.	--		250 mg/l rec.max.

Table V-F-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 27

Water Quality Characteristics	Surface Waters 1/	Ground Waters 2/	Current Standards 3/
Alisal & Gabilan Creeks for irrigation uses:	--		
--generally good to excellent			under 175 mg/1
--gen.good to selectively injurious			175-350 mg/1
--gen. injurious to unsatis.			over 350 mg/1
B:		0-0.3 mg/1	variable
Salinas R. near Gonzales	0.10-0.40 mg/1		(see below)
Salinas R. near Spreckles	0.10-0.80 2/		(see below)
Chualar Cr.@ Old Stage Rd.	about 0.20		0.5 mg/1 max.*
Quail, Natividad & Gabilan	--		0.5 mg/1 max.*
Salinas R., Alisal Cr., for irrigation uses:	--		
--generally good to excellent			under 0.5 mg/1
--gen. good to selectively injurious			0.5-2.0 mg/1
--gen.injurious to unsatis.			over 2.0 mg/1
Heavy Metals:			
Salinas R. near Gonzales			
Cd	under 0.0033 mg/1		0.01 mg/1 max.
Cr	under 0.0033		0.05 mg/1 max.
Cu	under 0.0033		1.0 mg/1 rec. max.
Fe	0.0073-0.0087		0.3 mg/1 rec. max.
Pb	under 0.0033		0.05 mg/1 max.
Mn	under 0.0033		0.05 mg/1 rec. max.
Zn	under 0.013		5 mg.1 rec. max.
estim. gross total	0.0678-0.0691		--

* Surface waters only

1. From Hydrology Data: 1970, Vol. III: Central Coastal Area, Bulletin No. 130-70, California State Dept. of Water Resources, Dec. 1971
2. From Ref. 7
3. From Ref. 18
4. From Ref. 6

generally vary in hardness from hard to very hard (i.e., generally they are above 120 mg/l of hardness as $CaCO_3$). Current standards reflect the use of Salinas River surface waters for municipal and domestic purposes and those of Alisal and Gabilan Creeks for irrigation and various recreational purposes. Both surface and ground waters range from fresh to slightly brackish (brackish being considered to range from 1,000 to 10,000 mg/l TDS). The reported values in Table V-F-1 indicate the range in values, the freshest waters being found during the wet season. Relative to ground waters, the higher TDS concentrations and salinities tend to be found closest to the Salinas River in the groundwater basin directly under the river's floodplain with lower values tending to be found in the groundwater basin under the upper valley slopes near the foothills. There also tends to be some correspondence between higher TDS values in the groundwaters and excessive nitrate concentrations and higher sodium concentrations.

b. Soils

The soils of Site 27 represent another typical and complex mix of the azonal soils of mountains and geologically young mountain valleys, complete with extensive lithosolic (stony or gravelly) and regosolic (alluvial) soils. These soils can be very generally classified as predominantly non-calcic chestnut and brown type warm dry soils; i.e., soils with nearly black (gray to brown), friable, organic-rich topsoils, and with subsoils showing small evidence of significant accumulations of calcium carbonate or gypsum in the lowlands (Ref. 2). The mean annual soil temperature is over 47°F. There is no evidence of any significant development toward the stratification typical of the podzolic soils of the geologically older mountainous and/or coniferous forest regions (i.e., significant leaching of the surface layers under the humus top cover and a dense clayey subsurface stratum) in those sections of Site 27 where this might be expected. There is, however, significant evidence of development toward the chestnut and brown (or steppe) and prairie types of chernozemic soils with the appearance of lime accumulations (calcareous horizons) in certain flat lowland soil profiles. There is, however, no significant development of distinct stratification between deep darker topsoils over lighter colored subsoils and substratum. The potential and/or historical natural vegetative cover for Site 27 is reportedly California steppe (Stipa) grasslands in the Salinas Valley lowlands, California oaklands (Quercus) or Board and Needle Leaf forests in the higher elevations in the general vicinity of Sub-Areas 27.1 through 27.4, and Chaparral or shrub (Adenostoma [chamise] Arctostaphlos [manzanita,] Ceanthus) in the higher elevations in the general vicinity of Sub-Area 27.5 (Ref. 2). More detailed soil information concerning the specific identified soil associations found in the Site Area is presented in Tables V-A-2, 3, 9, and 10 (Ref. 10K). (Background reference Section A-3c.)

The largest (and very lithosolic) soil grouping in Site 27 consists of the steep mountainous upland soils composed of generally acidic, gravelly, brownish sandy loam topsoils found in combination with generally more acidic, gravelly, brownish sandy loam subsoils. This soil grouping covers about 42 percent of the surface of Site 27 and predominates in Sub-Areas 27.1 and 27.2. They range in texture from moderately coarse to moderately fine; in depth from shallow to deep. They are well to excessively drained and are predominantly moderately to moderately rapid in permeability. They are found at elevations ranging from 400 feet on up; on slopes ranging from 30 to 75 percent; and over granitic bedrock. This soil grouping includes, in order of importance, the Sheridan, Cieneba-Sheridan, McCoy, and Vista soil associations. Their erosion hazard ranges from moderate to high and depends specifically on the slope, vegetative cover condition, and the specific soil type. Their topsoils consist predominantly of slightly acid, slightly hard, granular, brown and dark grayish brown gravelly sandy loams together with neutral, blocky, hard, dark brown clay loams and medium acid, granular, slightly hard brown sandy loams. Their subsoils consist of medium and slightly acid, granular, brown gravelly sandy loams; alkaline, blocky, hard, dark brown heavy clay loams; and medium acid, massive, light yellowish brown sandy loams. These are found over substratum ranging from (1) massive, weathered, coarse crystalline granite at 30 to 48 inches depth, (2) strongly weathered granite at 5 to 20 inches and 36 to 48 inches depth, and (3) granite and schist at 20 to 24 inches depth.

The second largest (and predominantly regosolic or alluvial) soil grouping in Site 27 are the moderately deep to deep, nearly level to strongly sloping lowland soils. They are composed of generally alkaline, brownish or grayish, partially gravelly and calcareous loamy top and subsoils. This soil grouping covers about 31 percent of the surface of Site 27. They generally range in texture from moderately fine to moderately coarse; they are well to excessively well drained and range in permeability from slow and moderately slow to rapid and very rapid. About 71 percent of these soils are slow to moderately slow in permeability; the remaining 29 percent range from moderately to very rapid in permeability. They are found at elevations ranging from 50 to 1000 feet, but mostly below 500 feet; in the floodplains and in the alluvial fans, plains, and low terraces of the Site Area; on slopes ranging from 0 to 9 percent; and generally over sedimentary alluvium of primarily granitic origin. This soil grouping includes, in order of importance, the Chualar, Salinas-Mocho, Farallone, Metz-Riverwash, Cropley, and Elkhorn soil associations. The soil grouping topsoils consist predominantly of neutral, granular, blocky, slightly hard, grayish brown sandy loams; neutral, massive, slightly hard, dark grayish brown gravelly sandy loams; moderately alkaline, blocky,

very hard, very dark gray clay loams; blocky, hard, calcareous, grayish brown silty clay loams; alkaline, weak, granular dark gray clays; and loose, calcareous light gray sands and silts together with stratified sands, gravels, and stones. Their subsoils consist predominantly of alkaline, blocky, very hard, brown clay loams; moderately alkaline to neutral, blocky to massive, slightly hard, dark brown gravelly coarse sandy loams; moderately alkaline, blocky, dark gray to grayish brown silty loams; massive, hard, calcareous, light grayish brown silty clay loams; alkaline, very hard, prismatic silty clays; and stratified, loose, light gray calcareous sands. These are found over the following predominant substratum: alkaline, loose, stratified brown sands and loams; neutral, loose, stratified brown loams or alkaline, massive, soft, brown coarse sands; massive, soft, calcareous grayish brown sandy loams; massive, hard, calcareous light brownish gray silty clay loams; moderately alkaline, massive, hard, grayish brown clay loams; and stratified, calcareous, light gray sands and gravels.

The third largest soil grouping in Site 27 (also predominantly regosolic or alluvial) are shallow to deep, strongly to moderately steep sloping lowland soils. They are composed of acidic brownish loam topsoils found in combination with alkaline brownish clay subsoils. This soil grouping covers about 16 percent of the surface of Site 27 and is concentrated in Sub-Area 27.2 and 27.5. They are well to somewhat poorly drained; their permeability ranges from slow to very slow. These soils are found at elevations ranging from 100 to 500 feet; on the gently undulating to moderately sloping terraces, and the strongly to moderately steep high terraces and steep dissected high terraces. They are found on slopes ranging from 2 to 50 percent; about 30 to 40 percent of them being on slopes between 2 and 9 percent, about 10 to 15 percent being on slopes ranging between 30 to 50 percent. These soils were formed from both granitic and sedimentary rock sources. The soil grouping includes, in order of importance, the Antioch-Gloria, Placentia, and Gloria-Placentia soil associations. The soil grouping topsoils consist of strongly acid, blocky, slightly hard, grayish brown loams; slightly acid, massive, hard, brown loams; and medium acid, massive, hard grayish brown sandy loams. Their subsoils consist of alkaline, columnar, very hard, yellowish brown clays; alkaline, prismatic, extremely hard, reddish brown clays; and alkaline, very hard, prismatic, dark brown clays. The associated substratum consist of moderately alkaline, blocky, hard, very pale brown sandy clay loams; reddish brown indurated hardpan; and alkaline, hard, massive, brown gravelly sandy loams. Their erosion hazard ranges from moderate to high and increases with slope.

The fourth significant soil grouping in Site 27 consists of the deep to very deep soils of the Arnold soil association. They cover about

11 percent of the surface area of the Site Area and are concentrated in Sub-Area 27.3. These soils are coarse to moderately coarse in texture and have developed in soft sandstone. They are excessively well drained and rapidly permeable. They are found at elevations ranging from 35 to 900 feet; on moderately steep to steep hills with slopes ranging between 15 and 50 percent. They consist primarily of medium acid, weak, blocky, slightly hard, brown loamy sand topsoils; medium acid, massive, slightly hard, brown loamy sand subsoils; together with a substratum of neutral to medium acid, massive soft, light gray sands or sandstone. Their erosion hazard is moderate.

c. Climatology and Meteorology

The climate of Site 27 shows the influence of the two distinctive climatic extremes of Monterey County, the coast and the inland valleys (Refs. 6, 10K and 18). The coast and the Monterey Bay area is characterized by warmer winters and cooler summers, frequent coastal fogs (which penetrate into the northern part of the Salinas Valley), and small daily and seasonal temperature ranges. The inland valley areas are characterized by wider climatic variations, with generally warmed and drier summers and cooler winters. Average air temperatures in January range between 44 and 48°F with the lower average being found in the higher elevations of the Site and generally in the southernmost sub-areas of the Site. Average July air temperatures range between 68 and 74°F; the higher temperatures being found in the southeastern sector of the Site while the lower average values are found in the northwestern sector of the Site (Sub-Area 27.3). Prevailing winds are from the northwest. The mean annual precipitation of Site 27 ranges from 19 inches in the northern part of the Site Area (Sub-Areas 27.1, 27.3, 27.4) to 13 inches in the southern part (Sub-Areas 27.2, 27.4, 27.5), with 83 percent of it occurring between November and March (from Table V-A-4). Most of this is in the form of rainfall, but occasional snowfalls have been observed along the crest of the Gabilan Mountain Range in the Site. A fairly heavy snowfall was observed during the field investigation of this Site. The average length of the growing season is 200 to 220 days without a killing frost (from Ref. 6). Mean annual pan evaporation has been estimated at 64.8 to 64.7 inches with about 64 percent taking place between May and September. Mean annual evaporation from shallow lakes and reservoirs ranges between 42 and 44 inches in the general vicinity of the Site (Ref. 6), while mean annual evapotranspiration from non-irrigated areas ranges between 10 to 12 inches. Mean annual potential evapotranspiration has been estimated to be 45.3 inches; while the mean annual vegetative requirement has been estimated to be 34.8 inches and 36.8 inches, respectively, for the northern and southern parts of the Site Area. Mean annual sunshine ranges

between 3000 and 3200 hours per year (Ref. 2) (Background reference Section A-3d).

Summary of Air Quality Conditions: The central and northern parts of Site 27 (Sub-Areas 27.1, 27.3, 27.4) are expected to exhibit less than 5 days per year when oxidant levels reach the 0.10 ppm mark (Ref. 142). Sub-Areas 27.2 and 27.5, near Gonzales, can be expected to exhibit between 10 to 15 days per year when oxidant levels are at or above the 0.10 ppm mark. Background information on oxidant levels and occurrences has been presented in Section A-3d. The Site's proximity to Salinas and other communities of the Monterey Bay area together with the projection of current development rates would indicate a general increase in the phenomena of higher oxidant levels. The degree to which current air pollution control programs, Federal, State, or local, will effect this in the immediate future period is uncertain.

3 - Environmental Setting Without the Project - Ecological

Site 27 is composed of two distinct geographic regions -- the Salinas River Valley on the west and the Gabilan Mountain Range on the east. The Salinas Valley section lies east of the Salinas River from Gonzales to just north of Prunedale and is primarily agricultural land. The eastern section includes the western slope of the Gabilan Range and is primarily chaparral brush, oak woodland and coniferous forest on the upper slopes.

a. Vegetative Cover

Site 27 supports five major vegetative cover types: agriculture, grasses and forbs, hardwood (oak woodlands), chaparral brush and coniferous forests (Figure V-F-6). The agricultural areas which comprise the southwestern one-third of Site 27 are used to grow lettuce, celery, potatoes, cabbage, cauliflower, etc. Native vegetation is not permitted to grow in the agricultural areas and even the edges of fields are cleaned of native vegetation.

Grasses and forbs are found bordering the eastern edge of the agricultural areas on the initial slopes of the foothills. Annual grass species of *Avena*, *Festuca* and *Bromus* have replaced the original perennial bunch grasses which once covered the valley and surrounding hills.

Further up the hillsides, chaparral brush replaces the forbs. These chaparral areas are interspersed with grassy areas. Coyote brush (*Baccharis pilularis*), coastal sage (*Artemisia californica*) and black sage (*Salvia mellifera*) are among the predominant brush forms (Table V-F-2).

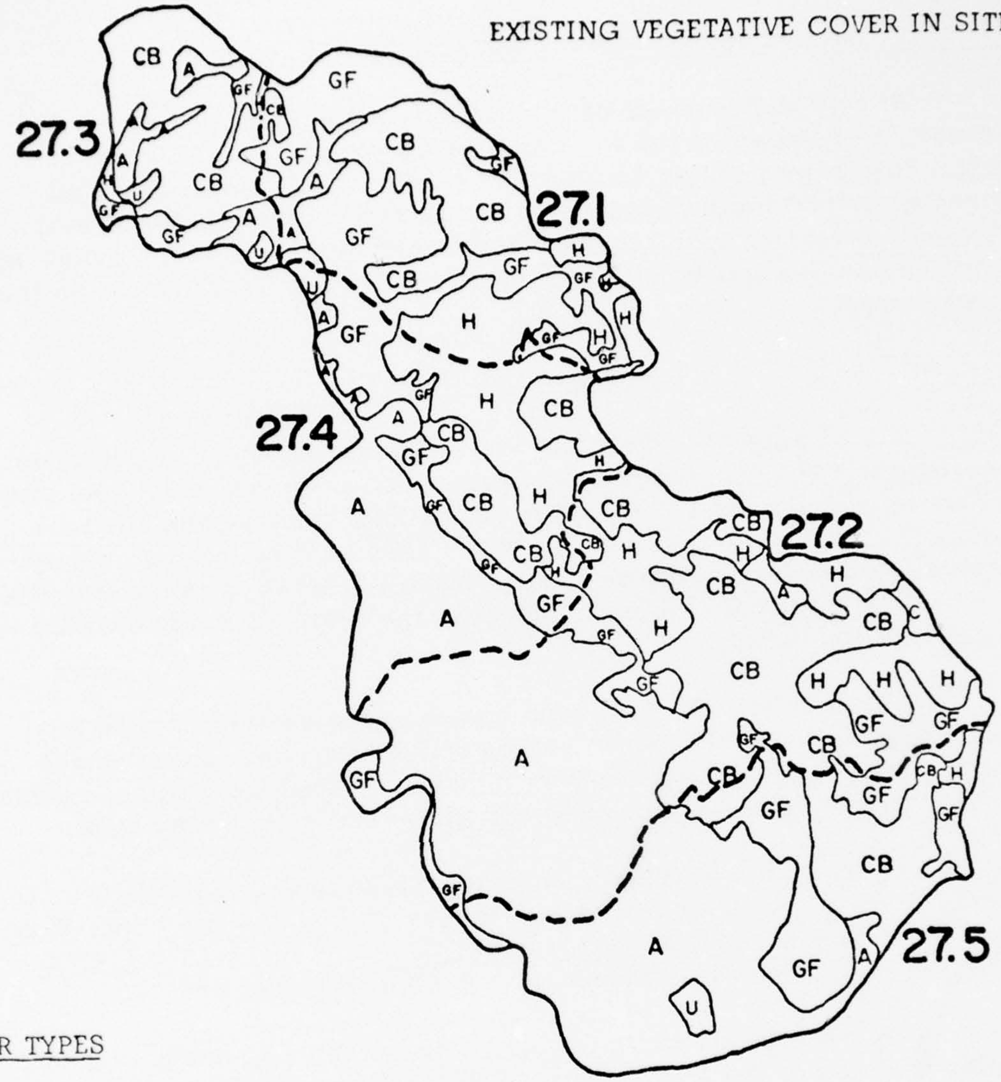
At higher elevations in the mountainous central portion of Site 27, oak woodlands are the predominate cover type. Interior and coast live oaks and canyon oak are the major oak species (Table V-F-2). Sycamores and valley oaks are found in some areas, especially in stream valleys in the Gabilan Range.

Along the ridge tops and at the highest elevations in the study area, coniferous species such as Coulter pine are found with golden chinquapin and big leaf maple. The portion of Site 27 nearest to the coast supports Monterey pine, *Eucalyptus* spp. and California bay.

Riparian vegetation is dominated by willows (*Salix* spp.), cottonwood, sycamore and red alder. Rare or endangered plants of Site 27 are listed in Table V-F-3.

Figure V-F-6

EXISTING VEGETATIVE COVER IN SITE 27



COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

Table V-F-2
DOMINANT NATIVE VEGETATION OF WASTEWATER LAND
APPLICATION STUDY SITE 27

Vegetative Cover Type	Scientific Name	Common Name
Grasses and forbs	*Bromus* spp.	Chess
	Festuca spp.	Fescue
	Avena spp.	Oats
Chaparral brush	*Baccharis pilularis*	Coyote brush
	Adenostoma fasciculatum	Chamise
	Arctostaphylos spp.	Manzanita
	Artemisia californica	Coastal sage
	Salvia mellifera	Black sage
	Rubus spp.	Blackberry
	Rhus diversiloba	Poison oak
	Foeniculum vulgare	Sweet fennel
	Ceanothus sp.	Ceanothus
Hardwoods (oak woodland)	*Quercus wislizenii*	Interior live oak
	Q. agrifolia	Coast live oak
	Q. chrysolepis	Canyon oak
	Q. lobata	Valley oak
	Q. dumosa	Scrub oak
	Q. kelloggii	Black oak
	Aesculus californica	California buckeye
	Platanus racemosa	Sycamore
Coniferous forest (coastal)	*Pinus radiata*	Monterey pine
	Umbellularis californica	California bay
	Pinus coulteri	Coulter pine
	Arbutus menziesii	Madrone
	Castanopsis chrysophylla var. *minor*	Golden chinquapin
Riparian	*Salix* spp.	Willow
	Populus fremontii	Cottonwood
	Platanus racemosa	Sycamore
	Sambucus sp.	Elderberry
	Nicotiana glauca	Tree tobacco

Table V-F-2 (continued)
DOMINANT NATIVE VEGETATION OF WASTEWATER LAND APPLICATION STUDY SITE 27

Vegetative Cover Type	Scientific Name	Common Name
	Acer negundo californicum	Box elder
	Rhus diversiloba	Poison oak
	Rubus sp.	Blackberry
	Rosa californica	Wild rose
	Typha sp.	Cattail
	Scirpus sp.	Bulrush
	Alnus oregona	Red alder

Table V-F-3
WASTEWATER LAND APPLICATION STUDY SITE 27
RARE, ENDANGERED AND POSSIBLY EXTINCT
PLANTS

Species	Local Habitat	Plant Community
Amsinckia grandiflora (a fiddleneck)*	Inner coast range and adjacent valleys	Valley grassland
Campanula californica (a bellflower)*	Near coast Point Reyes National Seashore	Freshwater swamp
Chaetopappa bellidiflora (an aster)*	Open dry rock slopes	Northern coastal scrub Coastal prairie
Parvisedum pentandrum (a stonecrop)*	Rocky places, often on serpentine 800-2500 feet Inner coast range	Openings in foothill woodland Chaparral
Tropidocarpum capparideum (a mustard)*	Alkaline low hills below 500 feet	Valley grassland
Arctostaphylos hooveri (a manzanita)**	No data	
A. montereyensis (a manzanita)**	No data	
A. pumila (Dune manzanita)**	Sandhills and woods	Closed-cone pine forest Northern coastal scrub
Monardella benitensis (a mint)*	No data	
Trifolium trichocalyx (a clover)*	Sandy places	Closed-cone pine forest

Table V-F-3 (continued)
WASTEWATER LAND APPLICATION STUDY SITE 27
RARE, ENDANGERED AND POSSIBLY EXTINCT
PLANTS

Species	Local Habitat	Plant Community
Fritillaria liliacca (a fritillary)*	Heavy soil, open hills and fields near coast	Northern coastal scrub Redwood Forest
F. viridea (Checker lily)*	Mostly in brush and among oaks and pines, below 2500 feet	Northern coastal scrub Mixed evergreen forest Chaparral Foothill woodland Yellow pine forest
Malacothamnus abbottii (a mallow)*	Among willows, Salinas River	
Ophiglossum californicum (Adder's tongue fern)	Vernal pools	
Eriastrum virgatum (a phlox)*	Sandy places Pinnacles National Monument	Coastal strand
Eriogonum butterworthianum (a wild buckwheat)*	No data	Chaparral
E. nortonii (a wild buckwheat)*	Dry rocky slopes 1500-4000 feet Inner coast range	
E. temblorense (a wild buckwheat)*	No data	

Table V-F-3 (continued)
WASTEWATER LAND APPLICATION STUDY SITE 27
RARE, ENDANGERED AND POSSIBLY EXTINCT
PLANTS

Species	Local Habitat	Plant Community
Polygonum montereyense (a knotweed)	Dry hard clay	
Delphinium hutchinsonae (a delphinium)*	No data	
Ceanothus rigidus (a California lilac)**	Sandy hills and flats	Closed-cone pine forest
	Monterey Peninsula	Northern coastal strand
C. rigidus var. albus (a California lilac)**	Monterey Peninsula	
Potentilla hickmanii (a cinquefoil)*	Rare, in marshy places places at scattered stations	Foothill woodland
Galium californicum ssp. luciense (a bedstraw)*	Open hills and woods below 3500 feet	Redwood forest
		Closed-cone pine forest
	Coast ranges	Mixed evergreen forest
Galium hardhamiae (a bedstraw)*	No data	
Castilleja latifolia (a paintbrush)*	Sandy places	Coastal strand
		Closed-cone pine forest
Cordylanthus littoralis (a birds-beak)*	Monterey	Back of coastal strand
		Closed-cone pine forest

Note:
- * a forb
- ** a bush

b. Fish and Wildlife

Fisheries: The Salinas River is the major waterway of the area, although it is often dry during the summer months from the Greenfield Diversion south to Salinas. The foothill streams of Site 27, such as Gabilan, Mud, Alisal, Quail and Chualar Creeks, are intermittent and at best only support a limited fishery during the wet season.

Anadromous Fish. According to the California Fish and Wildlife Plan (1965) (Ref. 30), the Salinas River is a minor steelhead stream. Approximately 500 spawners used the river annually and 600 angler-days were spent at the river with a yield of 0.06 fish per angler day. Today, because of water diversion that eliminates above-ground water flow (from Salinas to Chualar) in the river during the summer months, the steelhead run has been reduced significantly. Shifting sand destroys spawning beds and feeding habitat, and in combination with low flows, renders the Salinas River poor anadromous fish habitat.

Inland Fish. A minor warmwater fishery exists in Site 27. The Salinas River, which is often intermittent within the boundaries of Site 27, supports several species of warmwater fish (see Appendix, Chapter K). A warmwater fishery exists above the Greenfield Diversion and below Salinas on the Salinas River, adjacent to the boundaries of Site 27. Many small irrigation sumps, cattle watering ponds, and farm ponds were observed in the Salinas Valley and adjacent foothills. A warmwater fishery may exist in some of these ponds; and if not, there is a potential for establishing such a fishery.

According to California Department of Fish and Game personnel, trout may occur in the headwaters of small creeks draining the Gabilan Range, although the area is not surveyed by the Department. Trout occur in the Salinas River above the Greenfield Diversion (Ref. 146).

Wildlife: Several major wildlife habitat types are found in Site 27 -- chaparral, coastal sagebrush, woodland-grass, grassland, agricultural, riparian and a small amount of coniferous forest. Agricultural wildlife habitat, which is of very poor quality in the Site, occurs extensively in the Salinas Valley and to a lesser degree in some foothill areas. Chaparral, woodland-grass and grassland occur predominantly in the foothills and slopes of the Gabilan Range. Riparian habitat is abundant along the Salinas River levee and occurs intermittently along small stream channels in the foothills. The coniferous forest is restricted to the higher elevations of the Gabilan Range along ridges.

Big Game. Black-tailed deer are found over most of the site, except in the center of the Salinas Valley. Highest densities occur

in the woodland-grass type (30-60 per square mile) and densities run 10 to 30 per square mile in other habitat types (California Fish and Wildlife Plan, 1965, Ref. 30). Since 1965, deer densities have generally declined according to Fish and Game personnel. The decline has been attributed to a normal cyclic fluctuation in populations. However, loss of habitat by brush clearing to increase pasture for cattle has also contributed slightly to the recent decline in deer populations.

Wild (feral) pigs and Russian boar are common in Monterey county especially in the Santa Lucia Range (adjacent to the western boundary of Site 27). Within the last five years, populations of boar and pigs have increased in numbers east of Salinas, primarily through release of Russian boar. There has been an increase in depredation permits for boar in the Salinas Valley.

Upland Game. Monterey County contains excellent valley quail habitat (Ref. 32). Densities of 320 to 640 per square mile are found in the woodland-grass, coast sagebrush, riparian and agricultural (where cover is available) types. Densities of 60 to 320 per square mile are found in other types.

Brush rabbits and cottontails, which occur in the same habitat types as quail, are found in Monterey County in densities of 60 to 640 per square mile (Ref. 32).

Monterey County supports breeding populations of band-tailed pigeons and has been rated among the top ten counties for hunter bag of band-tailed pigeon for many years.

Mourning doves are scattered over the county primarily in the agricultural, grassland, and woodland-grass types. Populations may fluctuate annually, but densities of 60 to 640 per square mile are common during breeding and hunting seasons (Ref. 32).

Wild turkeys were planted by the California Department of Fish and Game and private parties at various locations in Monterey County several years ago. The plantings largely failed and today there are no significant populations of turkey present in Site 27.

Chinese ring-necked pheasants occur in the riparian and agricultural habitats in densities of less than 65 per square mile. In general, pheasant habitat in the Salinas Valley is poor because of the extensive clear farming practices and the lack of good grain crops for food and cover.

Waterfowl. The Salinas Valley does not have notably good waterfowl habitat. Suitable habitat is represented by various small farm ponds and a limited amount of water in the Salinas River. Winter densities of birds are usually less than 64 per square mile. Mallard, wood duck, cinnamon teal and other dabbler species probably breed in this area.

Nongame Wildlife. Mountain lion occur throughout the Gabilan Range following the major deer herds. The endangered California condor has been sighted just south of the southern boundary of Site 27.

Numerous nongame species can be found in the riparian lands adjacent to the Salinas River. Songbirds and raptorial bird species (kites and hawks) nest in the trees and numerous mammalian species (raccoon, opossum, coyote, etc.) may be found at the ground level. Animals observed during the field investigation of Site 27 are named in Table V-F-4.

Rare and Endangered Species. Eighteen species of rare or endangered animals are known or thought to occur within Site 27. This list includes one fish, two reptiles, fourteen birds and one mammal. They are listed in Table V-F-5.

1. Fish. Sacramento perch were once abundant in the Sacramento-San Joaquin system and the Pajaro and Salinas Rivers. Introduction of other centrarchids (bass and sunfish) has significantly reduced its numbers through competition. Because Salinas River flows within the study are now intermittent, the presence of the Sacramento perch is questionable. It may still occur downstream in waters receiving study area runoff.

2. Reptiles. The Alameda striped racer frequents chaparral and occasionally grassland, open woods and rocky slopes in the valley and foothill regions from San Francisco Bay to Monterey Bay (Ref. 36 and 97). Urbanization and subsequent removal of habitat are primarily responsible for this reptile's rare status. The two-striped garter snake may also be found in the study area. Its range extends throughout the coastal ranges from Monterey Bay to Baja California. Preferred habitat is in and around rocky streams with protected pools near shore. The exact population status of the two-striped garter snake is undetermined at present (Stebbins, 1966).

3. Birds. The California brown pelican occurs along the Pacific Coast from Canada to Mexico, including the Monterey Bay vicinity. Reproductive failure attributed to pesticide contamination has caused the endangered status of this bird. The brown pelican may infrequently stray into the study area; however, the great concern should be in maintaining pesticide levels below toxic concentrations downstream from the study area in Monterey Bay, the bird's natural habitat.

Table V-F-4
ANIMALS OBSERVED DURING FIELD INVESTIGATIONS
ON DECEMBER 7, 1972
OF WASTEWATER LAND APPLICATION STUDY SITE 27

Birds	Mammals
Mallard Turkey vulture Red-tailed hawk Marsh hawk American kestrel (Sparrow hawk) California valley quail American coot Killdeer Western gull Rock dove Red-shafted flicker California acorn woodpecker Scrub jay Stellar's jay Common crow Robin Starling House sparrow Red-winged blackbird Brewer's blackbird Western meadowlark Brown towhee Oregon junco Song sparrow White-crowned sparrow Mourning dove	Numerous animal tracks were seen in Salinas River areas. Some were identified as raccoon and coyote.

Table V-F-5
RARE AND ENDANGERED ANIMAL SPECIES
IN SITE 27 AREA

Common Name/Scientific Name	Status	Occurrence
Fish:		
Sacramento perch (*Archoplites interruptus*)	U	x
Reptiles:		
Alameda striped racer (*Masticophis lateralis euryxanthus*)	R	x
Two-striped garter snake (*Thamnophis couchi hammondi*)	U	*
Birds:		
California brown pelican (*Pelecanus occidentalis*)	E,U	x
Aleutian Canada goose (*Br nta canadensis leucapareia*)	E	*
Tule white-fronted goose (*Anser albifrons gambelli*)	E	*
Red-bellied red-shouldered hawk (*Buteo lineatus elegans*)	U	*
Ferruginous hawk (*Buteo regalis*)	U	x
Southern bald eagle (*Haliaeetus leucocephalis leucocephalis*)	E	*
American osprey (*Pandion haliaetus carolinensis*)	U	x
Prairie falcon (*Falco mexicanus*)	R	*
American peregrine falcon (*Falco peregrinus anatum*)	E	*
California clapper rail (*Rallus longirostris obsoletus*)	E,R	x
California black rail (*Laterallus jamaicensis coturniculus*)	R	*
Alaskan short-billed dowitcher (*Lininodromus griseus* ssp.)	U	*
California yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	R	*
Yakutat fox sparrow (*Passerella iliaca meruloides*)	U	*
Mammals:		
Big-eared kangaroo rat (*Dipodomys elephantinus*)	U	*

E - Endangered
R - Rare
U - Status undetermined
x - This species or subspecies definitely or probably occurs on the wastewater management area
* - Occurrence of this species or subspecies on the wastewater management area is uncertain or questionable

The Aleutian Canada goose and the tule white-fronted goose are both winter inhabitants of coastal California. Marshes, lakes and bays serve as resting areas. Food consists of grain, young grasses and forbs.

Several raptorial birds (birds of prey), including the red-bellied red-shouldered hawk, ferruginous hawk, southern bald eagle, American osprey, prairie falcon and American peregrine falcon have historically inhabited the study area. The osprey and ferruginous hawk probably occur in the area, but the presence of the other raptors is uncertain. Most of these birds have experienced population declines due to pesticide contamination of their food chain, destruction of nesting sites, human encroachment upon their natural habitat and hunting or trapping by man.

The California clapper rail is a resident of salt marshes in San Francisco Bay and Elkhorn Slough. This range does not include the Site area, but because Elkhorn Slough lies immediately adjacent to the northern portion of the area, the California clapper rail's presence has been noted. Destruction of salt marsh habitat by filling and draining has reduced the rail's status to endangered. The California black rail, whose distribution and population numbers are presently unknown, has historically existed in similar habitats from Tomales Bay south to Baja California.

The Alaskan short-billed dowitcher winters along the Pacific coast from central California to Baja California, frequenting coastal or near-by inland mudflats, marshes and ponds. Its status is presently undetermined and it may visit the study area occasionally.

The California yellow-billed cuckoo historically nested along stream channels from Shasta County to southern California. Although it is now infrequently seen in California due to destruction of streambank riparian vegetation, the possibility of its presence should be noted.

The Yakutat fox sparrow's status is undetermined, but historically it has frequented chaparral, open woodland and forest undergrowth throughout mountainous regions of the western United States and Canada.

4. Mammals. The big-eared kangaroo rat occupies chaparral covered slopes throughout the southern Gabilan Range in both Monterey and San Benito counties and may exist as far north as the study area. Exact range and population status of this species is undetermined at present.

Wildlife and Fish Diseases:

Wildlife Diseases. Under present conditions, there are no serious wildlife disease occurrences in Monterey County except foot rot

among deer. Foot rot, caused by the anaerobic bacteria *Spherophorus necrophorus*, causes periodic losses of deer in Monterey County. The bacteria thrives in mud caked onto hooves which has been previously contaminated by droppings from infected animals. The disease has a higher incidence of occurrence in dry seasons (late summer) when deer are concentrated around remaining waterholes. Management efforts to control the disease include deposition of sand or gravel around the edges of watering holes to prevent build-up of mud.

Infectious bovine tuberculosis, which afflicts cattle and swine, has recently occurred in northern San Luis Obispo County south of Site 27. There is a potential for this disease to be transferred into the wild pig and boar populations in Area 27 from infected animals that escape and become feral. However, this is not expected to occur according to California Department of Fish and Game personnel.

Waterfowl diseases such as avian cholera and fowl botulism are nonexistent or occur in very minor outbreaks among waterfowl found in Site 27.

Fish Diseases. There is no specific information on fish diseases of this area. For a general discussion on commonly occurring fish diseases and parasites, refer to the discussion of this subject under the present environment section of Site 4.

c. Ecological Systems

Site 27 is dominated by agricultural land, especially the Salinas Valley bottomlands and alluvial aprons. Land management and cropping techniques presently used by the agriculturists have effectively omitted any natural wildlife habitat in these areas. Hedgerow, canal bank and field edge cover is almost nonexistent. Clear-cropping is practiced to utilize the maximum available space and at the same time control rodent pests through removal of habitat.

The most abundant and diversified array of wildlife found in Site 27 exists in the riparian lands along the Salinas River. The value of this land has been recognized in the California Protected Waterways Plan. The Salinas River has been designated a Class I extraordinary wildlife waterway-riparian land. The vegetative mixture of trees, brush and annual and perennial grasses and forbs supplies food, cover, nesting sites and rest areas for numerous birds and mammals. Alteration of this plant species complex would also change the species composition of wildlife utilizing the vegetation for food or cover. Smaller areas of good riparian growth are found along the foothill stretches of Gabilan, Mud, Chualar, Johnson and McCoy Creeks.

The grassland-chaparral and grassland-woodland border areas in the Gabilan Range support a large array of wildlife. The close proximity of two separate habitat types bring together two wildlife assemblages and also produce a habitat for wildlife that cannot thrive on either of the separate types alone. Deer, quail, dove and cottontail are common in these border areas throughout the foothill sections of Site 27.

There are no significant good quality marsh lands within Site 27.

d. Recreation Resources

Site 27 was estimated to have a gross recreational user potential of 120.59 million visitor days per year. There is no concentration of actual recreational use within the area except at Fremont Peak State Park.

Steelhead fishing is available seasonally along the Salinas River, while the Salinas Valley agricultural lands support hunting for dove, quail, pheasant, duck and rabbit. The foothill and upland sections of the study area (Gabilan Range) are popular and productive for deer, quail and cottontail hunting.

The higher elevations of the Gabilan Range are used recreationally for hiking, camping, picnicking, horseback riding and sightseeing. Fremont Peak State Park is the focal point for these activities.

Present Public Facilities: Fremont Peak State Park is the only major public recreational facility within Site 27 (only a small portion of the park is actually within Site 27). The 244 acre site offers camping, picnicking, hiking, horseback riding and sightseeing opportunities at its location on the crest of the Gabilan Range. A list of its facilities and past and projected use are given in Table V-F-6.

Table V-F-6

RECREATION FACILITIES OF FREMONT PEAK STATE PARK

(244 acres)

Facilities

Camp units	10
Picnic units	20
Parking units	50
Trails (miles)	1

Attendance

Year	Day Use	Overnight Use	Total
1969	21,326	4,695	26,021
1980	27,937	6,150	34,087
1990	36,877	8,118	44,995
2000	44,252	9,741	53,993

Royal Oaks Regional Park is located just outside the northern boundary of the Site and should not be substantially affected by the project as it is not within the Site 27 watershed.

Present Private Facilities: Private recreational development within Site 27 is very limited. The Salinas Bowmen, Inc. maintain an archery range west of Crazy Horse Road in the northern foothill section of the study area. This was the only private recreational facility noted during field observations. There are private deer hunting clubs throughout the Gabilan Range, but because licenses are not required in all cases, accurate information on location and size is not available.

Hunter and Angler Use. Hunting pressure within Site 27 is most accurately represented by the California Department of Fish and Game post-season hunter survey and annual wildlife management unit reports. Table V-F-7 presents hunter kill data extrapolated from the 1970 post-season survey for Monterey County and is not specific to the Site area. Hunter use-day information is not available on a county-wide basis.

Table V-F-7

1970 HUNTER SURVEY - MONTEREY COUNTY *

	Bag	Hunters
Pheasant	1,900	800
Quail	58,700	5,600
Dove	73,700	5,600
Pigeon	27,400	4,300
Jackrabbit	23,900	2,200
Cottontail	15,300	2,800
Tree squirrel	21,200	2,800
Ducks	20,400	1,800
Geese	0	0
Jacksnipe	1,000	200
Coots	1,000	200
Deer	4,000	8,600

* Extracted from unpublished Department of Fish and Game data sheets, Sacramento, California.

The 1972 wildlife unit management report for the San Benito deer herd reported a three-year average deer kill of 1,104 buck and 114 antler-

less deer (1969-71). The San Benito herd ranges the length of the Gabilan Range within both San Benito and Monterey Counties, the percentage of this kill figure specific to the study area is unknown.

The 1965 California Fish and Wildlife Plan (Ref. 30) estimated that the Salinas River supported an annual steelhead run of 500 spawners with 600 angler-days expended on the fish. Fishing success was estimated to be .06 fish per angler day (1 fish per 16.7 angler-days). At present, the status of this run is unknown. River diversions at Greenfield and Chualar significantly reduce and seasonally eliminate above-surface flows in the Salinas River from Greenfield to Salinas. The California Department of Fish and Game recognizes no major warmwater fishery within the study area. However, a minor warmwater fishery may be present in the wet season when stream flows are adequate. Several species may occur seasonally in the Salinas River when there is an above-surface flow. Farm ponds in the valley and foothill sections may also support small warmwater fisheries.

Open Space. Monterey County, through its open space element of May 1972, has designated most of Site 27 as open space. Several different classifications are involved. Excluding a strip of urban development along SR 101 from Salinas to Chualar, the valley bottom land west of Old Stage Road is set aside as prime agricultural land. This is a continuance of present land use. Small areas of relatively flat alluvial fan and stream valley bottom immediately east of Old Stage Road are classified as agriculture/rural residential. This category facilitates long-range plans for modest residential development in low foothill areas presently used for pasture and limited crop production. Three small plots of recreational open space are designated in the northern portion of the study area -- Fremont Peak State Park and two other areas (located between U.S. Highway 101 and Crazy Horse Road) not described in the open space element. The final open space category found within Site 27 is wildlife, grazing, watershed and agriculture. This broad grouping includes the hilly and mountainous eastern half of the study area.

Urban and rural residential lands west of Crazy Horse Road, along U.S. Highway 101 from Chualar to Salinas, and surrounding Gonzales are the only lands within the study area not prescribed as open space.

Future Public Facilities: The County of Monterey and the State of California have proposed no new recreation sites within the boundaries of Site 27. There is, however, a proposed state riding and hiking trail that enters the study area from across the Salinas River near Spence. The route will parallel Hartnell and Zabala Roads to Old Stage Road, then continue northwest along Old Stage Road, Crazy Horse Road, and Echo Valley Road to San Miguel Canyon Road and the study area boundary.

A regional park and reservoir is proposed on Natividad Creek immediately west and outside of the study area boundary near the town of Natividad. Wastewater applied to the Natividad Creek drainage within the study area could possibly affect the park site once it is established.

e. Protected Waterways Designation

The Salinas River is the only waterway within Site 27 that has a protected status. It is listed as a Class I extraordinary wildlife waterway under the riparian lands subsection.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

It has been estimated that the foothills along Monterey Bay and the Salinas Valley may contain potential archaeological sites (Ref. 11). No reported archaeological surveys of the area have been conducted. The Site Area is known to have been in the southernmost area of lands occupied by the Costanoan Indians prior to early Spanish conquest and colonization (Ref. 2).

The only historic landmark of note in Site 27 is the site of the Battle of Natividad, California Registered Historical Landmark No. 651 (Ref.15). The site is located in Sub-Area 27.1 at the intersection of Crazy Horse and San Juan Grade Roads. The Battle of Natividad took place on November 16, 1846 when the combined American forces under Captains Charles D. Burass and Bluford K. Thompson clashed with Mexican Californians under the command of Commandante Manuel de Jesus Castro. The Americans saved a large drove of horses for Lieutenant Colonel John C. Fremont who subsequently concluded an armistice at Cahuenga in January 1847.

b. Scenic Locations

SR 156, from the western perimeter of Sub-Area 27.3 to its junction with U.S. Highway 101, and US 101, from its junction with SR 156 northward to the northern periemter of Sub-Area 27.3, are proposed for inclusion in the California State Scenic Highways System (for background reference, see Section A-3f). Monterey County has also proposed a scenic roadway in Site 27. It is proposed to begin at the Salinas River just west of Chualar (in Sub-Area 27.2) and follow Chualar River Road and Chualar Road northeast to Old Stage Road, and subsequently follow Old Stage Road northwest and finally northeast to the Monterey-San Benito County line just west of the eastern perimeter of Sub-Area 27.1. A branch of this proposed scenic route will leave Old Stage Road at its junction with Crazy Horse Road (Sub-Area 27.1) proceed along Crazy Horse Road to its junction with US 101 and subsequently along US 101 to the Monterey-San Benito County line (just north of the northern perimeter of Sub-Area 27.3).

The roadway leading to Fremont Peak State Park (along the eastern perimeter of Sub-Area 27.1) and the park itself offer excellent scenic views of the Salinas Valley westward and the San Juan Valley northward, (the San Juan Valley being the valley of the San Benito River eastward of its confluence with the Pajaro River). At the present time, these scenic vistas are unimpeded by any sort of man-made structure.

These scenic values are somewhat marred by the near universal appearance of roadside refuse scattered all along the edges of the Site Area's many roads and concentrated particularly at natural and specifically provided stopping and pull-off viewing areas.

Some idea of the scenic values of Site 27 can be anticipated from some of the views presented in Figure V-F-5.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

A change in the species composition due to wastewater and applications is the first impact.

Discussion: The application of large amounts of water on the proposed rapid infiltration areas in the Salinas Valley (in all sub-areas) would convert present irrigated farm land to a wet meadow or marshland plant community. A change in the dominant vegetation types would also result in a different animal community composed of species which are better adapted to the new plant community (marsh).

Wastewater applied to the grassland and coastal sage shrub in the foothill areas of the Gabilan Range would result in a change in the present annual grass species. The sage shrub species may incur luxuriant growth due to the application of wastewater. For additional discussion of this subject refer to Impact 12 for Site 5 (Section C-6L).

Remedial, Protective and Mitigative Measures: Refer to the discussion of this topic concerning Impact 12 for Site 5 (Section C-6L).

b. Impact 2

Loss of wildlife species through loss of habitat (lands, vegetation) to general project facilities is the second impact.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of these subjects concerning Impact 5 for Site 4 (Section B-6e).

c. Impact 3

Loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems is the third impact.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of these subjects concerning Impact 12 for Site 4 (Section B-6e).

d. Impact 4

The TDS buildup in soils that receive treated wastewater is the fourth impact.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of the subjects concerning Impact 7 for Site 5 (Section C-6g).

e. Impact 5

Change in the existing water quality due to wastewater land application is the fifth impact.

Discussion: Surface and subsurface drainage of wastewater could reduce the quality of surface water in Site 27. The estimated recovered wastewater contains total dissolved solids (TDS) in concentrations that could degrade the water quality of Site 27.

TDS	Surface Drainage	Groundwater or Sub-surface Drainage: Forest Pasture Crop	Groundwater or Sub-surface Drainage: Rapid Infiltration
Existing water (from Table V-F-1)	50-1180	294-1240	
Recovered water (from Table V-A-7)	400-1000	800-2000	450-1100

The upper limits of the recovered wastewater TDS is very near the upper limit of the existing surface water TDS. They are expected to be higher than current groundwater quality, which already in certain areas are showing the effects of irrigation. The Salinas River, in general, is considered a source of domestic water supplies, consequently a 500 mg/l recommend TDS maximum is applicable to it (Ref. 18). Electro-conductivity (EC) is an indirect measure of TDS and variable EC objectives have been established for various surface water in Site 27 and for ground waters in terms of their fitness as irrigated agriculture water supplies (see Table V-F-1). The quality of undiluted surface and subsurface drainage would exceed the EC objectives for Chualar, Quail, Natividad, and Gabilan Creeks and would constitute an agricultural water supply considered to be generally good to selectively injurious (depending upon crop sensitivity).

The Salinas River flows above ground only seasonally in the Site area. Therefore, it is problematical whether surface drainage of recovered wastewater would have an adverse impact on the aquatic life that occurs in the river during seasonal above-ground flows.

Remedial, Protective and Mitigative Measures: Monitoring of all outflows will be necessary to control the water quality of the effluent. High TDS may require pre- or post- application treatment to prevent degradation of surface or ground water. Substantial recovery of applied wastewater and their re-use elsewhere would severely reduce the potential impact that might otherwise exist.

f. Impact 6

Possible increase in wildlife diseases due to application of wastewater is the sixth impact.

Discussion: The application of wastewater is not expected to increase the incidence of wildlife diseases in Site 27.

Wastewater application to the foothills of the Gabilan Range would improve the oak-chaparral-grass deer range and thus contribute to the health of the animals. Summer applications could create more watering areas and prevent crowding around original ones.

This would be a beneficial impact. Although any additional permanent watering areas created should be managed to prevent the creation of muddy edges. This can effectively be remedied (small scale) by the use of sand or gravel around the edges of watering holes.

g. Impact 7

Loss of vegetation, wildlife habitat and wildlife on soil disposition areas is the seventh impact.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of these subjects concerning Impact 13 for Site 4 (Section B-6m).

h. Impact 8

Change in the micro-climate caused by increased available moisture is the eighth impact.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of these subjects concerning Impact 4 for Site 5 (Section C-6d).

i. Impact 9

Expansion of marshland in the Salinas Valley is the ninth impact.

Discussion: The application of large amounts of wastewater to the rapid infiltration areas proposed for the Salinas Valley would create large areas of marshland. The occurrence of marshland would replace the existing agricultural community with a new marshland biotic community. This change would dictate different land uses. Recreational uses, such as waterfowl hunting, nature observations, and possibly fishing, would increase at the expense of present agricultural land uses.

This would be a beneficial impact, since marshland habitat has been seriously reduced throughout the state.

j. Impact 10

Possible changes in upland gamebird habitat through land use changes is the tenth impact.

Discussion: Any change in agricultural land uses, encouraged by wastewater application, that would increase production of cereal grains or allow "weedy edges" around fields would increase gamebird habitat in the Salinas Valley. This is not expected to happen since the present table vegetable crops have a high cash value but possibility exists.

Proposed rapid infiltration use, as outlined in Section F-1b, would convert about half of the valley into marshland habitat and marshland is not notably good upland gamebird habitat.

k. Impact 11

Increased mosquito and midge populations is the eleventh impact.

Discussion, and Remedial, Protective, and Mitigative Measures: Refer to discussion of these subjects concerning Impact 16 for Site 5 (Section C-6p).

l. Impact 12

Potential increase in streambank recreational opportunities is the twelfth impact.

Discussion: The use of wastewater to augment flows of the Salinas River, Gabilan, Chualar and other creeks of Site 27 could increase streamside recreation potential. Provided that the quality of the wastewater was high and if it did not contain TDS in excess of 1000 or summer temperature in excess of that tolerable by fishes chosen for management in the streams, a permanent fishery could become established, increasing angler-use days for the area. Water contact sports, such as swimming and boating, could be greatly increased from their present status provided that the water quality was high (especially low bacterial counts). Above-ground water flows in rivers and streams have certain aesthetically pleasing properties. This would be a beneficial impact.

m. Impact 13

Possible generation of unpleasant odors is the thirteenth impact.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of the subjects concerning Impact 21 for Site 5 (Section C-6u).

n. Impact 14

Possible increase in heavy metal concentrations is the fourteenth impact.

Discussion, and Remedial, Protective, and Mitigative Measures: Refer to the discussion of these subjects concerning Impact 4 for Site 4 (Section B-6d).

o. Impact 15

Reduction in roadside scenic values is the fifthteenth impact.

Discussion: Construction of permanent above-ground distribution systems along roads in the foothill areas of the Gabilan Range could be aesthetically displeasing to residents and visitors on Site 27.

In the Salinas Valley area of Site 27 there would not be a reduction of scenic value. The above-ground distribution of wastewater would be of the same nature as present agricultural irrigation systems.

Remedial, Protective, and Mitigative Measures: Above-ground distribution systems for wastewater should be located away from roadways and recreation sites.

Planting of native trees and shrubs would mitigate the undesirable scenic effects of delivery and dispersal systems clearly visible from roadways.

p. Impact 16

Possible increase in fish diseases due to the application of wastewater is the sixteenth impact.

Discussion: Wastewater could introduce new diseases and parasites into Site 27 which were not present before wastewater application. This is especially possible if wastewater comes from sources with fish stocks such as hatcheries, tropical fish hobbyists, and commercial fish processors.

Additional wastewater would also create more habitat for certain aquatic snail species that are intermediate hosts for some fish parasites. Parasitic copepods may also increase in numbers.

This impact may not be a major problem since there is no major fishery on Site 27.

Remedial, Protective and Mitigative Measures: Initiate whatever measures are necessary to prevent the increased disease or parasite load, such as:

1. Pre- or post-application treatment of wastewater to prevent degradation of surface water quality.

2. Prevent the introduction of new diseases or parasites.

3. Prevent increases in intermediate host species or control of those species if prevention is impossible.

q. Impact 17

Enhancement of inland and anadromous fisheries in the Salinas River and its tributaries is the seventeenth impact.

Discussion: At present, the above-ground flow of the Salinas River is intermittent within the study area. Application of wastewater within the Salinas River drainage in sufficient amounts to establish a permanent above-ground flow could establish a permanent warmwater fishery and augment anadromous fish runs. Permanent flows in the smaller creeks draining the Gabilan Range (Gabilan, Mud, Alisal, Chualar, Quail, Johnson and McCoy Creeks) could facilitate establishment of trout fisheries at the higher elevations. The actual benefits derived from increased flow would be dependent upon the water quality of the introduced waters. This would be a beneficial impact.

r. Impact 18

Possibly increase in eutrophication of Monterey Bay is the eighteeth impact.

Discussion: All surface and subsurface runoff would naturally leave Site 27 through the Salinas River which is a tributary to Monterey Bay. Wastewater applied to the study site that reaches Monterey Bay has the potential of accelerating eutrophication through the addition of nitrogen, phosphorous and organic matter. Because specific water quality data is not readily available for Monterey Bay; the probability of increasing eutrophication is undeterminable but, nonetheless, deserves mention. Bacteriological contamination of the bay through waste discharge has necessitated closing of the bay beaches in the past (Ref. 149). Critical marine life areas exist on the bay at Hopkins Marine Life Refuge and Pacific Grove Marine Gardens Fish Refuge.

Remedial, Protective, and Mitigative Measures: Control wastewater quality pre- and post-application to insure lowest possible total nitrogen and total phosphorous in waters discharged to the Salinas River.

Apply wastewater to areas with least likelihood of drainage (surface or subsurface) into the Salinas River.

Substantial recovery of applied wastewater and their re-use somewhere else would severely reduce any eutrophication hazard that might otherwise exist.

s. Impact 19

Eutrophication of the Salinas River and its tributaries by increased runoff from pasture land and feed losts is the nineteenth impact.

Discussion: Undiluted recovery water from the wastewater

application sites is estimated to contain 6-20 mg/l total nitrogen in surface drainage and 3-20 mg/l total nitrogen in groundwater. Total phosphorous figures are 2-4 mg/l in surface and 1-2 mg/l in groundwater flows. These levels will be greatly increased in areas where wastewater is allowed to flow across animal feed lots. Nitrogen and phosphorous compounds stimulate eutrophication. The lower foothill slopes of the Gabilan Range and foothill valleys of Gabilan, Mud, Chualar, Quail and Johnson Creeks are heavily grazed, and substantial amounts of nitrogen rich manure accumulate. Beef cattle feed lots on the banks of Chualar and Johnson Creeks have concentrated amounts of animal manure. Increased sheet and overland flow of water through these areas will increase eutrophication of the Salinas River and its tributaries, both surface and subsurface. This would be a major impact on fish and wildlife dependent on Salinas River water within and downstream from the project site.

Remedial, Protective and Mitigative Measures: Apply wastewater to areas other than heavily used pasture land.

Restrict overland and stream flow along Chualar and Johnson Creeks in order to avoid feed lots.

Maintain non-grazed buffer strips between heavily used pasture land and major surface drainage features.

Treatment of pre-application and/or recovered wastewaters should be considered if required; "pretreatment" includes the reduction of estimated increased nitrogen and phospherous into the wastewater collection systems of the Waste Source Region. Significant decreases in TN and TP in raw wastewaters will produce corresponding decreased concentrations in all subsequent effluents.

t. Impact 20

Bank cutting and slumping and subsequent destruction of riparian vegetation along the Salinas River and its tributaries is the twentieth potential impact.

Discussion: All streams within Site 27 are now subject to intermittent flows. Application of wastewater in sufficient amounts to create perennial surface flows may stimulate bed shifting, sand movement, bank cutting and slumping along streams supporting heavy riparian vegetation. Removal of this vegetation through inundation, undercutting or change in groundwater levels will destroy prime wildlife habitat. Dove, pheasant, quail, raptors and numerous mammals frequent the riparian growth. The Salinas River is presently listed as an extraordinary wildlife waterway -

premium riparian lands subsection. The extent of vegetative removal and subsequent displacement of wildlife will depend on the volume of wastewater reaching the streams as overland flow. If destruction of the streambed occurs causing high turbidity, it may prevent the establishment of a fishery.

Remedial, Protective, and Mitigative Measures: Maintain Salinas River and tributary flows at levels below those conducive to bank erosion.

Implement a program to prepare streams for increased runoff and simultaneously enhance or maintain natural values.

Restrict wastewater application to areas least likely to increase surface flow in streams.

u. Impact 21

Increased erosion on over-grazed slopes with subsequent removal of vegetation and silting of streams is the twenty-first impact.

Discussion: The grassland slopes bordering the foothill sections of Quail, Johnson and Chualar Creeks are heavily grazed. Application of vast quantities of wastewater to these sparsely vegetated slopes may create erosion problems. The underlying soils are sandy and poorly consolidated, facilitating accelerated erosion under high-runoff conditions. Removal of grassland or brush types of vegetation also removes wildlife habitat utilized by numerous mammals and birds. If Site 27 streamflows are augmented by the addition of wastewater and possibly improving inland fisheries, erosion and subsequent siltation of streams would be a detriment to those fisheries.

Remedial, Protective, and Mitigative Measures: Maintain wastewater application to grazed slopes below levels that might stimulate slope erosion.

Restrict wastewater application to areas other than heavily grazed slopes.

Restrict wastewater application to periods with lowest natural soil moisture.

Seed grassland slopes with vegetation more resistant to erosion (ex. rye grass).

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The twenty-second impact for consideration is that on the soil profile, particularly on soils not presently being irrigated.

Discussion: The irrigation of pasture and forest lands not now being irrigated will obviously produce a net increase in the water through-put or leaching through the soil profile. This will tend to enhance the processes of calcification in the pasture lands and podzolization in the coniferous forest lands. However, it is estimated that the net effect during the use-life of the project will be negligible. These processes operate within a geological time-frame; the use-life of the project is very small in comparison. Apart from this, the potential enhancements of the processes of calcification in pasture lands due to increased water input are or can be severely mitigated due to two principal factors. The first is inherent in the nature of the irrigation process. Calcification depends upon the return of calcium to the soil upon the death and decay of the grass crop. Irrigated pasture lands, by definition, involves a substantial removal of the grass crop from the area through the "harvesting" of the animals grazed upon it, and, therefore, a removal of the calcium accumulated in the grasses. Secondly, the management of leaching rates can control the leaching of calcium and magnesium out of the surface layers and particularly it can control and specifically minimize the subsequent deposition in the subsurface layers. Extensive calcification in the subsurface layers of the soil profiles tends to throttle percolation rates. Since the impact on the soil profile is expected to be insignificant, no major remedial, protective, or mitigation measures need to be seriously considered at this point.

Figure V-F-1 delineates the location in environmentally "sensitive" areas within Site 27. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas. The "sensitive" areas for Site 27 consist of:

1. Riparian vegetation adjacent to the Salinas River (along the western perimeter of Sub-Sites 27.5, 27.2, and a small part of 27.4).

2. Riparian vegetation adjacent to Mud and Gabilan Creeks (in Sub-Site 27.1).

3. The western portion of Fremont Peak State Park (Sub-Site 27.1).

4. Old Stage Road in Sub-Site 27.1, a portion of a proposed Monterey County scenic roadway.

5. SR 156 (west of Prunedale and US 101) and US 101 (from SR 156 northward) an unofficial scenic highway in Sub-Site 27.3.

SECTION G

G. WASTEWATER LAND APPLICATION SITE 28: SOUTHERN SAN MATEO COUNTY COAST AREA

1 - Project Development

a. Present Land Uses

Site 28 covers almost all of southwestern San Mateo County and projects slightly into two small northwestern corners and the northernmost tip of Santa Cruz County. It includes all the western slopes of the Santa Cruz Mountains, from the crest to the ocean, draining into the Pacific Ocean from Miramontes Point-Three Rocks on the north (just south of Manhattan Beach) to the southern drainage limit of the Gazos Creek watershed (just north of Franklin Point). Half Moon Bay is located just over 2 miles north of the Site's northern limits. San Francisco is located about 20 miles to the north; Redwood City about 6 miles to the northeast; downtown San Jose about 14 miles to the east; and Menlo Park, Palo Alto, Los Altos, and Sunnyvale varying between 5 and 10 miles east of the Site's eastern limits. The eastern perimeter of Site 28 is provided by the drainage divide along the Santa Cruz Mountains between the coastal drainages of Site 28 and areas to the east draining into South San Francisco Bay, for all practical purposes this being State Route 35, Skyline Blvd. The southern part of this eastern perimeter is also the San Mateo-Santa Clara County line from about Alpine Road south half way, and then the Santa Cruz-Santa Clara County line south to Saratoga Gap. The southeastern perimeter is provided by the drainage divide between Site 28 and areas to the southeast draining into the northern end of Monterey Bay. This line generally coincides with or lies just west of SR 9 from Saratoga Gap south to Waterman Gap, and then SR 236 to a point just northeast of its junction with China Grade road. The southern perimeter is provided by the southern watershed limits of Gazos Creek except for a short section to the east just barely east of China Grade road. The western perimeter is provided by the Pacific Ocean. Use Figures V-G-1 and V-A-7 for location reference.

Site 28 occupies about 126,900 acres. For study purposes, it has been divided into two sub-areas as shown in Figures V-G-1 and 2. These sub-areas and their areas are as follows:

Sub-Area No.	Sub-Area Designation	Area in Acres
28.1	Pescadero Creek	38,500
28.2	San Gregorio Area	57,300
28.3	Butano-Grazos Creek Area	31,100

Sub-Areas 28.2 and 28.3 have been informally subdivided into drainage basin units for purposes of reference in Section G-2a.

(From Vol. II, Figure II-E-1, Pg

(From Vol. II, Figure II-E-1, Pg. E-13)

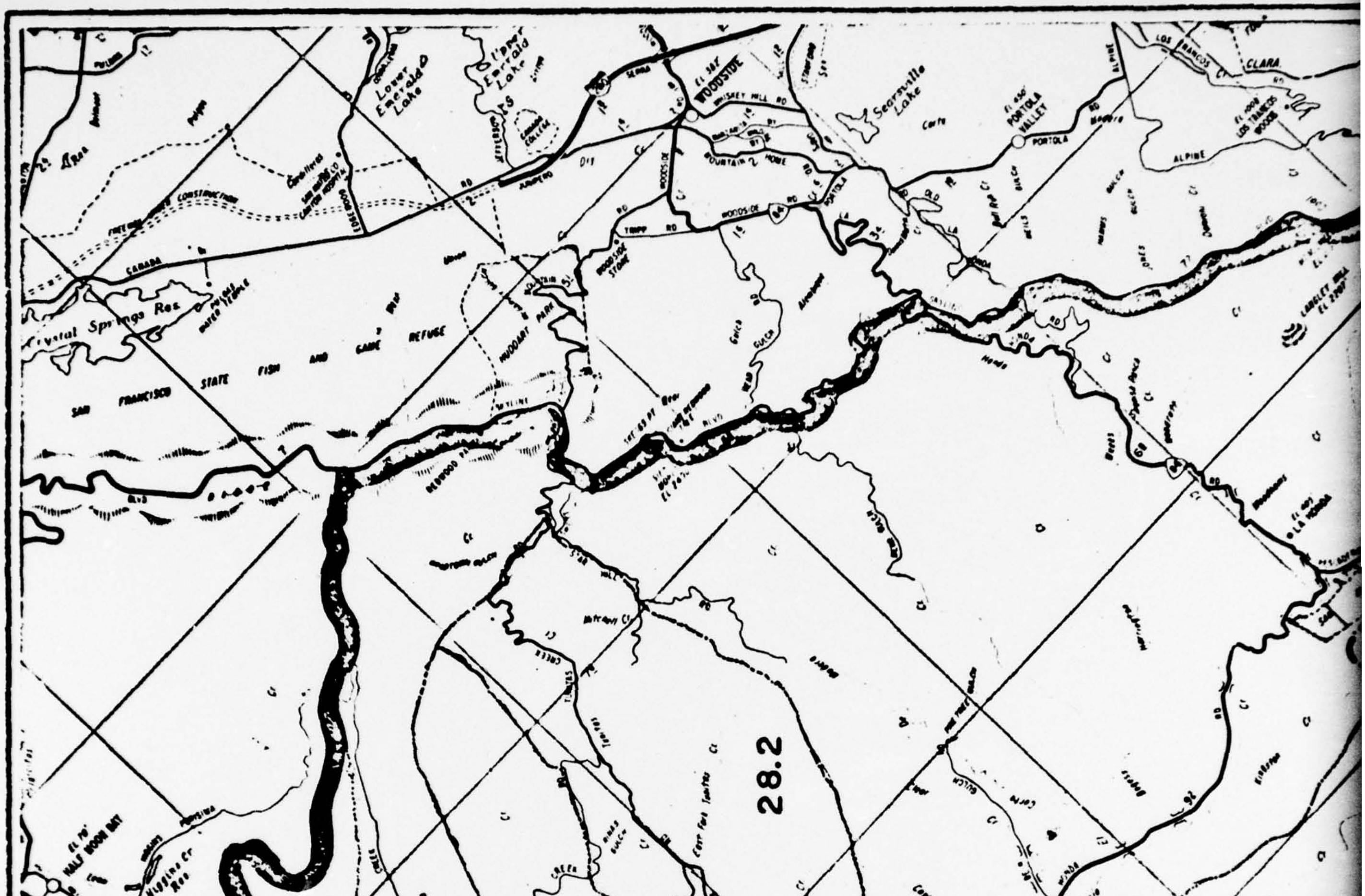

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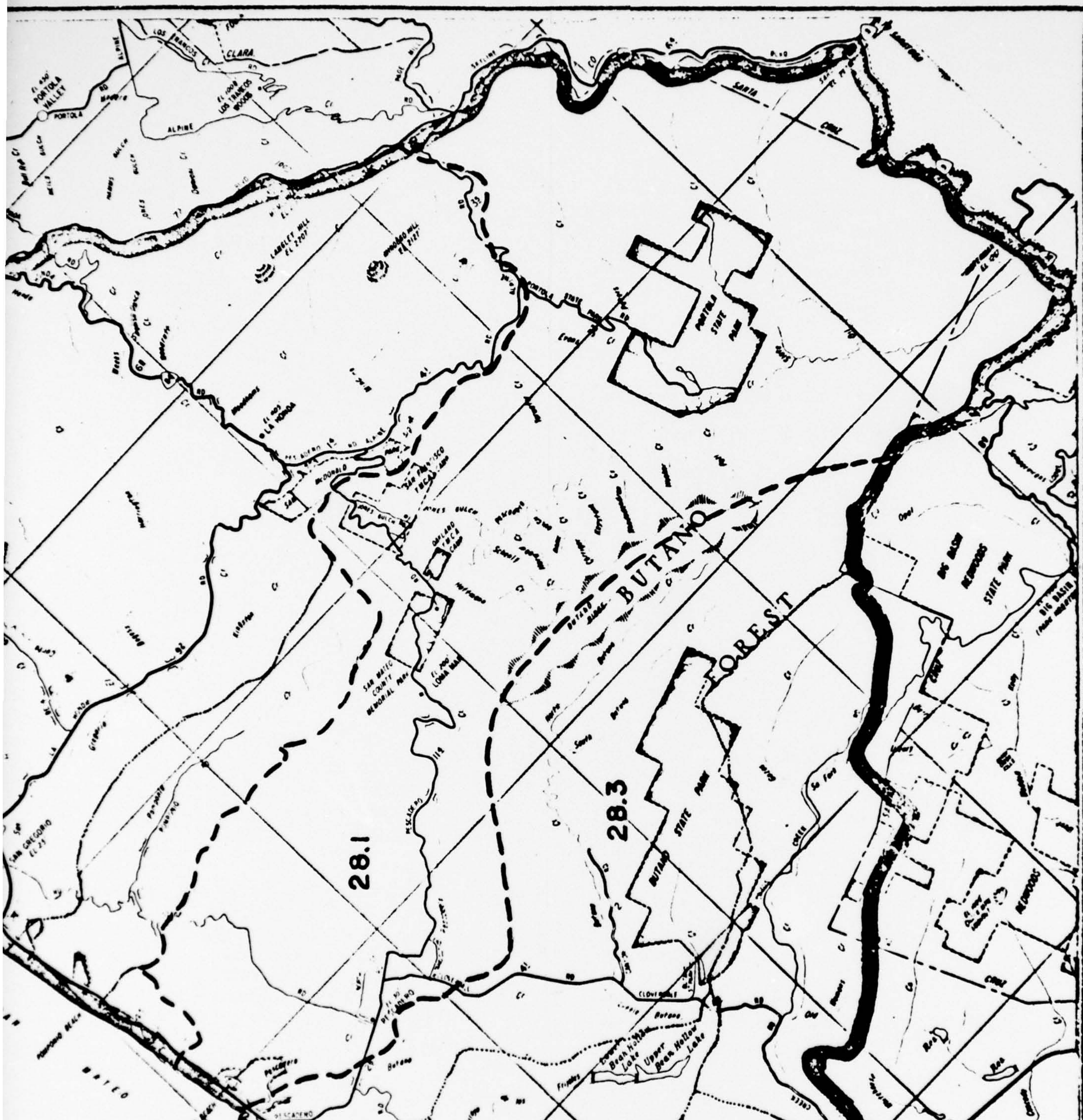
Figure V-G-2



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Agriculture is the most areally extensive land-use in the lower elevations. This includes range, pasture, and crop cultivation (both irrigated and dry), and occurs in the western coastal band. Grasslands occupy the foothill elevations, chaparral on the dry slopes, hardwoods in the hill crest elevations, and coniferous forests at higher elevations. Recreation and associated land-uses are also important. There are a number of State beaches on the coast and a number of State and County parks located in the interior of the Site Area. Pescadero Creek specifically has been designated a Class III steelhead river under the California Protected Waterways Plan. The Site Area also has a moderately extensive system of roads and it is dotted, here and there, with many small towns and communities.

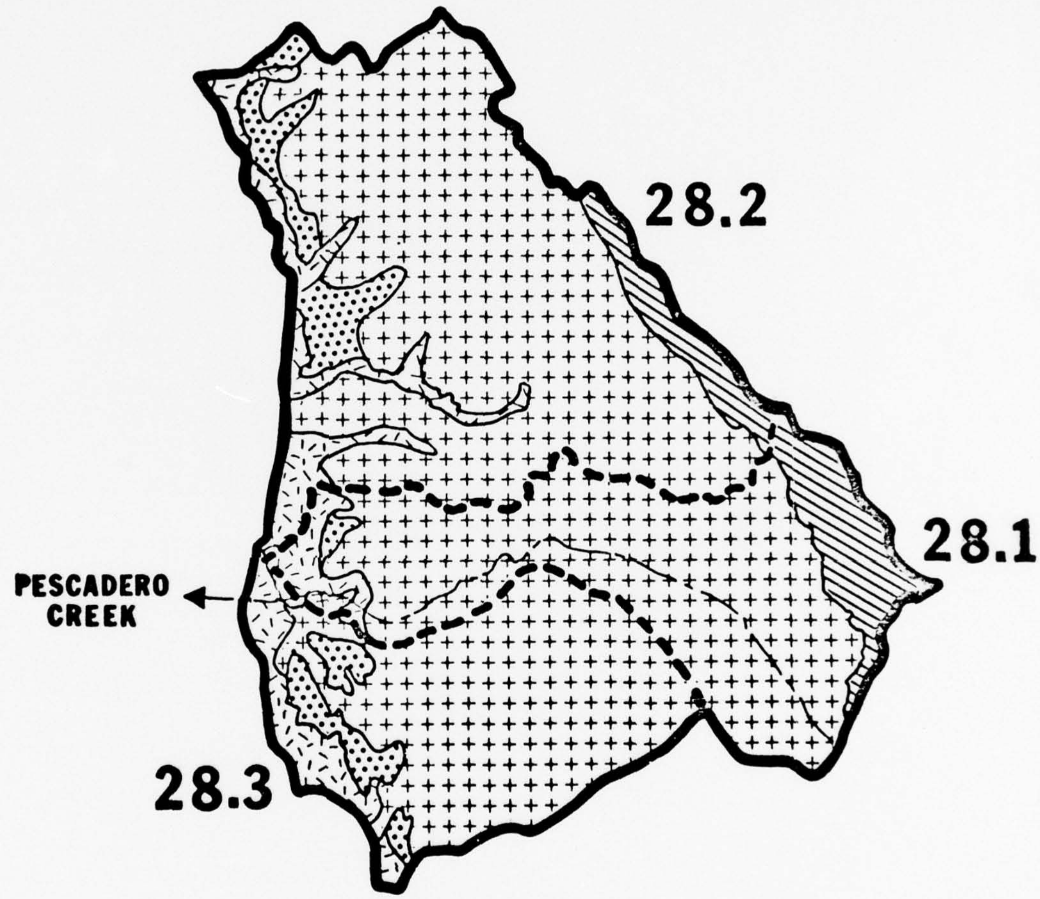
b. Development Objectives

Site 28, like Site 18, is representative of various coastal and Coast Range sites. It is particularly representative of an area close to substantial urban development and with a potential for developing or improving redwood forests for commercial or recreational use. Furthermore, recreational uses can be further enhanced through stream flow augmentation. This stream flow augmentation can be particularly important where agricultural stream water diversions have diminished the salmonid or warmwater fisheries through excessive streamflow depletion. The effect of additional water on riparian, marsh, and estuarine communities will require extensive investigation before any hard decisions can be made on the advisability of adding treated wastewaters to the present stream systems either directly or by subsurface flow.

There has been considerable interest in San Mateo County to maintain the lands on the ocean side of the couny in their natural states. Local water supplies for municipal and agricultural uses are generally deficient in this area. The Corps of Engineers has been investigating proposals for dams on Pescadero Creek in order to provide for a water supply for areas north of Half Moon Bay. Because of the presence of several groves of natural redwoods in Site 28, redwood culture protection and enhancement is another possible project objective.

Proposed land uses and types of land applications based on soil capabilities are shown in Figure V-G-3. This figure and Figure V-G-4 also show areas which will almost certainly be excluded because of excessive elevation (over 1500 feet). Areas with slopes over 30 percent predominating have been delineated in Figure V-G-4. These latter areas are strong candidates for exclusion because of erosion enhancement and possible landslide conditions. These areas have been delineated as a result of on-site inspections and subsequent topographic map analysis. Recommended unit application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10. The areas most suitable for

PROPOSED AND POTENTIAL LAND USES FOR WASTEWATER LAND APPLIC



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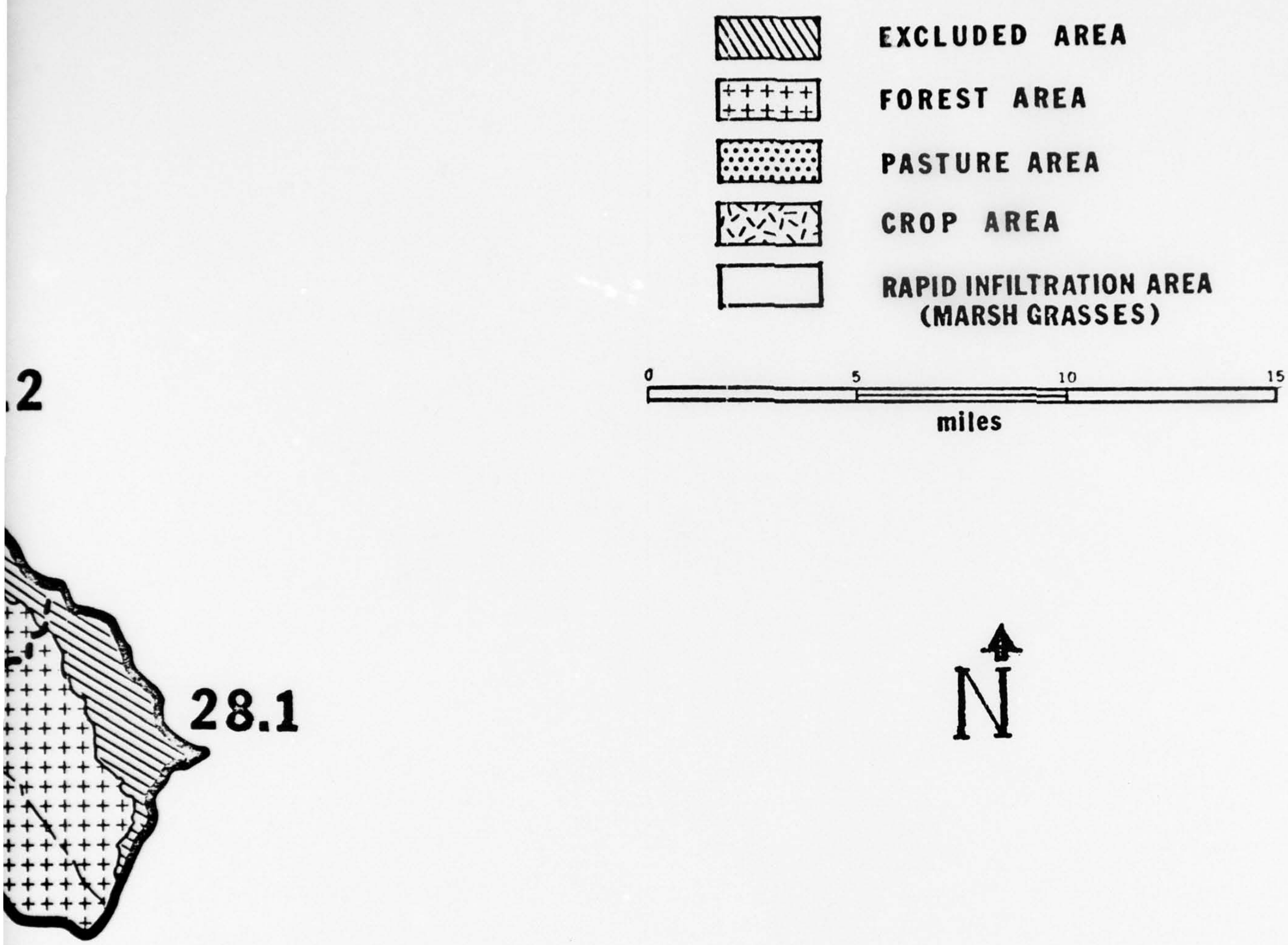
WASTEWATER LAND APPLICATIONS



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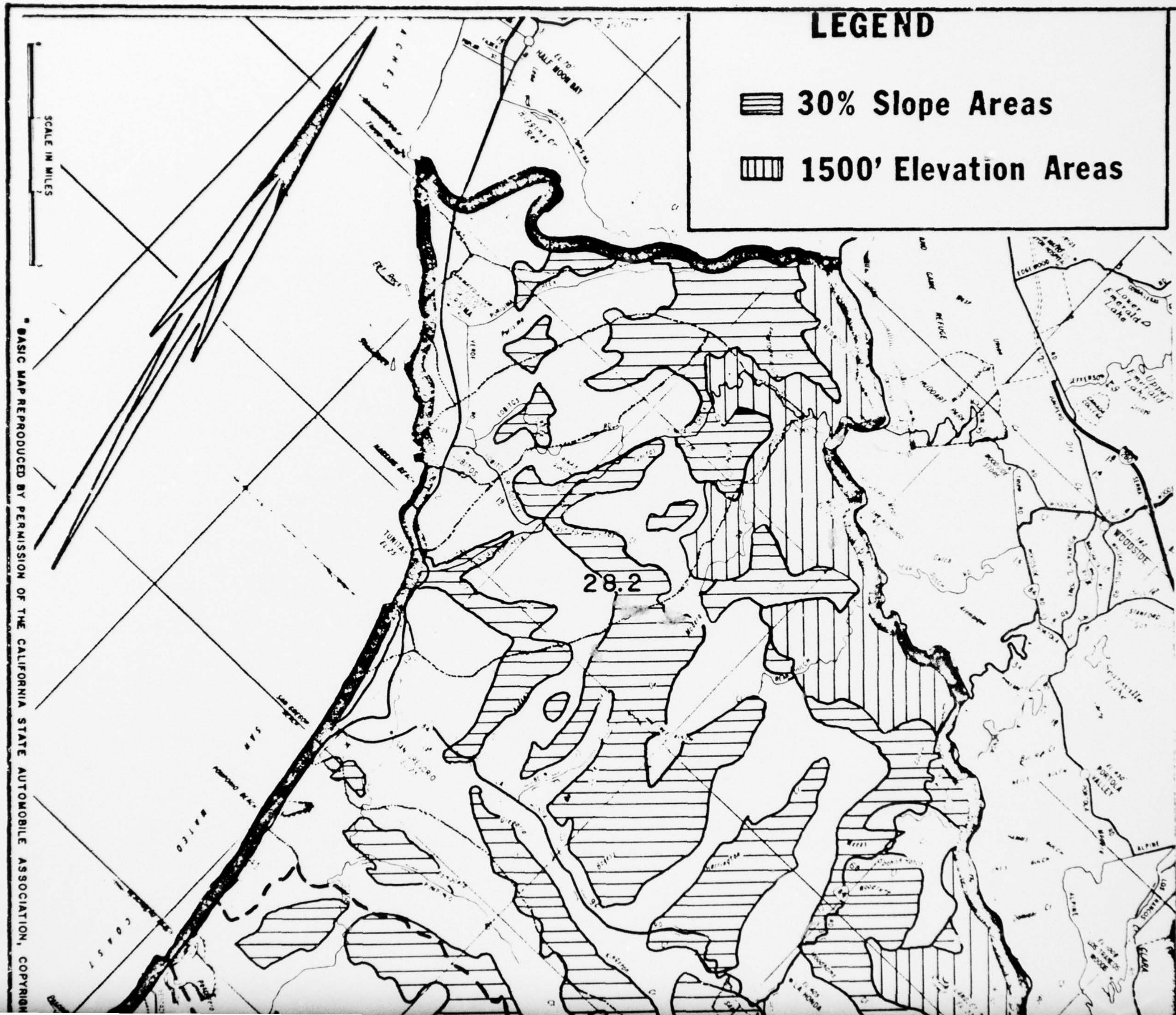

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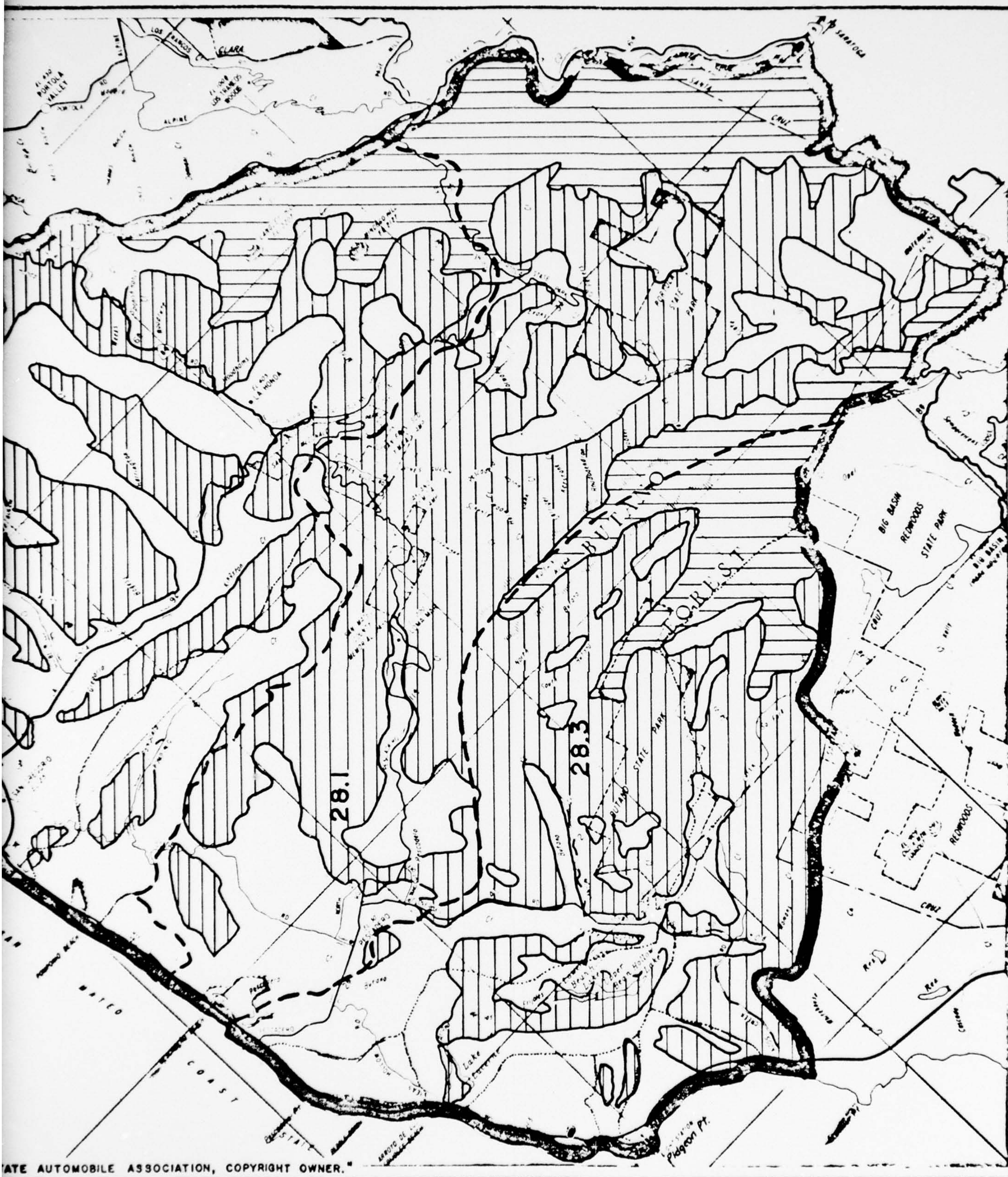
Figure V-G-4



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wastewater land application are located in the western part of the Site Area and in some plateau and valley areas in the central part of the Site Area.

The possible sources of wastewater for land application to parcels in Site 28 and the possible specific combinations of them will depend upon the degree and extensiveness of the regionalization in the collection and treatment of wastewaters thought advisable. The possible sources include western and southeastern San Francisco to the north; Pacifica, Daly City, Half Moon Bay and other communities on San Mateo's coast, also to the north; all of urbanized and suburbanized San Mateo County to the northeast and east; the San Jose urbanized area to the east; and perhaps some of the communities of south Alameda County along South San Francisco Bay. These treated wastewaters can be brought into the Site Area best along several of the major and minor roadways into the Site Area. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible wastewater sources indicated above. The estimated quality of recoverable wastewaters is that presented in Table V-A-7.

The distribution and recovery systems will follow the management and development outlines presented in Sections A-7a, b, and c. The conveyance of wastewaters into Site 28 has to surmount some major increases in elevation. The lowest 'barrier' elevation is about 200 feet; it is encountered by wastewaters coming down SR 1 from the Pacific coast side of San Francisco and northern San Mateo County. These areas have the same elevations as the coastal lowlands of Site 28. Wastewaters coming from the San Francisco Bay side of San Mateo County and southeastern San Francisco would encounter a low elevation of 871 feet along SR 92 between the Belmont Area and Half Moon Bay. This would be the lowest 'barrier' elevation for any regional treatment plant in the vacinity of Redwood City. A more direct route would encounter a low elevation near the junction of Purisima Creek Road and Skyline Blvd., about 1980 feet. This in the headwaters area of the Purisima Creek drainage just north of Tunitas Creek Road. A lower elevation "gap" of 1461 feet is located further south at the intersection of La Honda Road and Skyline Blvd. (just below Palo Alto). The lowest elevation "gap" along the entire eastern perimeter is located at Waterman Gap at the junction of SR 9 and SR 236; it is 1267 feet and it is situated southwest of metropolitan San Jose. From this foregoing brief analysis it is clear that the probabilities are high that most of the land application sites in the lower elevations can be served by a gravity system. The higher elevation sites could also be served by gravity systems if detail design indicated the superior benefits of a more direct route entering Site 28 along the eastern perimeter and hence involving pumping for conveyance over a much higher elevation point.

It is expected that major distribution lines will be along the road ways with laterals branching off at selected elevations at the higher entrance

points to the many valley areas and following these elevation lines around the valley perimeter for purposes of gravity distribution. If SR 1 along the coast is employed as a major distribution line, the system will probably be a pressure system under the gravity head developed enroute to the Site Area. Major laterals will take off up the various valley lowlands following the general pattern discussed in Section A-7c for the Capay Valley. For possible conveyance lines coming over the ridge line along the eastern perimeter of the Site, there is also the possibility of using flat sloping drainage divides for distribution purposes in the forest areas. Such lines could "take off" from the major incoming conveyance lines and work their way down some of these flat ridges distributing treated wastewater from selected elevations by means of downhill aimed sprinkler systems simulating periodic light rainfall. Such lines could also eventually tie into the valley perimeter system discussed briefly above.

The amount of sub-surface recovery systems in Site 28 is expected to be limited to the relatively small amount of acreage proposed for crop irrigation. The pasture lands and forest lands can, for recovery purposes, use small catchments or impoundments on the many small tributary drainage channels which serve these areas together with pumping facilities to convey away such waters as may require post-treatment or which can be directly re-used.

Site 28, like Site 18, lies wholly within the Coast Range geomorphic province and specifcally wholly within the outer or coastal slope portions of the range. In the case of Site 28, this is the coastal or western slopes side of a section of the northwestern end of the Santa Cruz Mountain range, this section providing the backbone for the San Francisco-San Mateo peninsula and a divide between their direct coastal drainages and their South San Francisco Bay drainages. The Santa Cruz Mountains continue southeasternly providing the west well for the Santa Clara Valley and a north-northeasternly rim for the Monterey Bay coast area.

The Site's two characteristic and generalized physiographic regions are (1) low open mountains which generally rise to elevations between 1000 and 2400 feet along most ridge lines, and (2) the small intermountain valley lowlands, generally young and V-shaped, and the coastal terrace lowlands. The area is 20 to 50 percent gently sloping with over 75 percent of the gentle slopes being in the lowlands, a characteristic of most of the Coast Range from Santa Barbara County north to the lower portions of the Russian River water shed. Elevations in Site 28 range from sea level along the coast to 2400 feet at Sierra Morena (in the high headwaters area of El Corte de Madera Creek, a tributary in the San Gregorio Creek water shed, Sub-Area 28.2) and slightly over 2720 feet at Saratoga Gap (in the high headwaters area of Oil Creek, a tributary in the Pescadero Creek water shed, Sub-Area 28.1). Site 28, like the rest of western San Mateo County, consists, in part, of terraces that interfinger into the lower foothills. The terraces, foothills, and low mountains are in turn cut by many small streams producing many small valleys along their channels. These small valleys include both old marine terraces and more recent alluvial fans. Along the coast, a series of nearly level to hilly wave-cut terraces have been developed. The mountainous uplands themselves consist of a number of complex ridges with rugged slopes that vary reportedly from 40 to 60 percent. Figures V-G-5a, 5b, and 5c show some typical views of the Site Area.

a. Geology and Hydrology

Summary of Geology: The oldest subsurface strata in Site 28 is composed of the sedimentary and meta-sedimentary rocks of late Mesozoic age, specifically Upper Cretaceous (60 to 100 million year old) marine sedimentary rocks; sandstone, siltstone, and conglomerates. This is the predominant subsurface formation in the Pidgeon Point coastal area; i.e. everything west of a line running from the mouth of Butano Creek south through lower and Upper Bean Hollow Lake to the mouth of Whitehouse Creek just southeast of Franklin Point.

1. NE to E Up Purisima Creek Valley on Purisima Creel

2. N-ENE Panorama Up Tunitas Creek Road near E Fork Up Tunitas Creek Dra

3. ENE-SE from San Gregorio Road just E of Stage Road Up

Site 28

eek Valley on Purisima Creek Road

E Fork Up Tunitas Creek Drainage

oad just E of Stage Road Up and Across San Gregorio Creek Valley

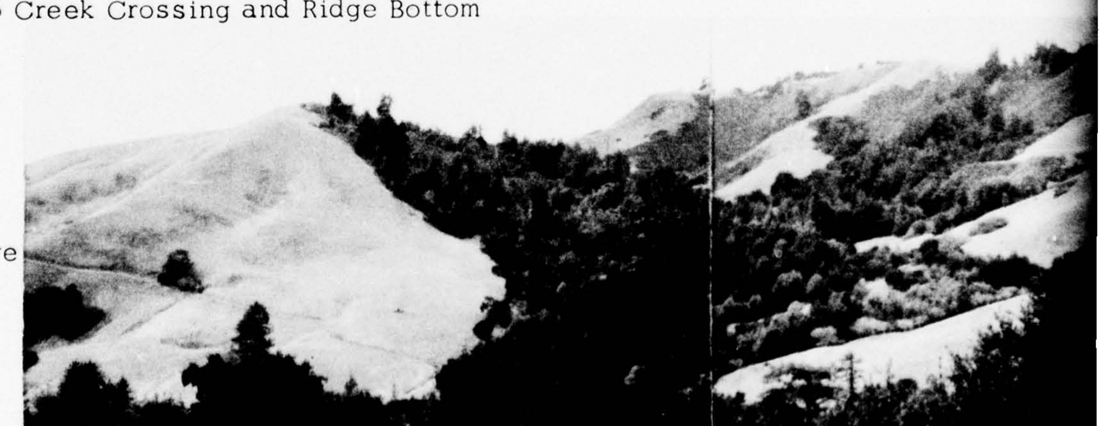
4. N Up Coast from Pescadero Road just E of Highway 1 Showing the Mouth of Pescadero and Butano Creeks

5. NE toward Pescadero from

6. W toward Upper Bean Hollow Lake and Arroyo de los Frijoles on Cloverdale Road at Little Butano Creek Crossing and Ridge Bottom

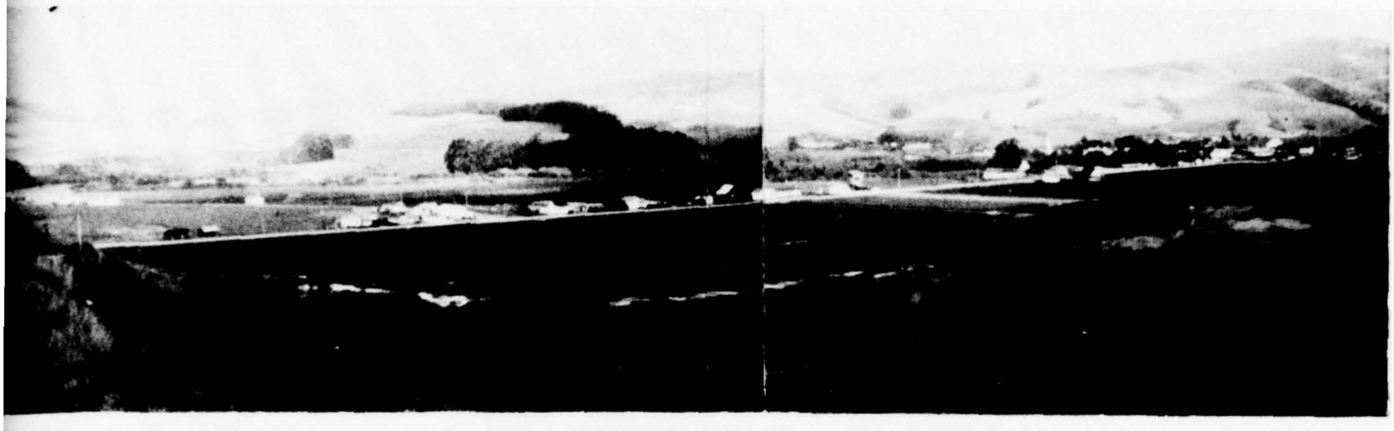
7. Across Little Butano

9. NW in Santa Cruz Mountains from La Honda Road above Weeks Creek in San Gregorio Water Shed



2

Site 28



5. NE toward Pescadero from Bean Hollow Road just Above Butano Creek

7. Across Little Butano Creek Valley

8. Eroding Slopes by Road on La Honda Road between Spanish Ranch and Woodruff Creeks

10. E in Santa Cruz Mountains from Alpine Road between Summit
and Portola State Park Road in Upper Pescadero Creek Water Shed

11. NE Up Tunita
from Tunita

3. Gazos Creek Looking E from Gazos Creek Road
Upper Crossing

Site 28

11. NE Up Tunitas Creek Channel from Tunitas Creek Road

12. W toward the Ocean from Skyline Blvd. and Kings Mountain Road

14. Forest-Grassland Vista Looking North from Alpine Rd 1 mile W of Portola State Park Rd

The predominant subsurface formations in the rest of the Site Area are composed of older (Tertiary period) Cenozoic marine sedimentary and meta-sedimentary rocks. Eocene (40 to 50 million year old) marine sandstones and shales are primarily located in the eastern one-third of Sub-Area 28.3 (the Butano Forest area), the high headwaters area along most of the eastern perimeter of Sub-Area 28.2, and in a central band across the San Gregorio Creek watershed in 28.2. Lower Miocene (22 to 28 million year old) marine siltstones underlie a north central band in Sub-Area 28.3 generally west and north of the two Eocene strata just discussed in that sub-area, and predominate in the easternmost part of Site 28 generally east of a line between Langley Hill (eastern part of 28.2) to the intersection of China Grade road with SR 236 in the southeast corner of 28.1) Middle Miocene (18 to 22 million year old) marine shale and sandstone strata are concentrated in a northwesterly directed band through the central part of Sub-Area 28.3 generally east of Cloverdale Road, west of the Eocene strata described above, and extending northwesterly to just north of Pescadero Creek. Middle and/or Lower Pliocene (6 to 12 million year old) marine conglomerates, sandstones, and shales are concentrated in a narrow band running northwesterly through 28.3 between Lower and Upper Bean Hollow Lakes and Cloverdale Road and underlie the predominant areas of western and central 28.1 and western and southwestern 28.2 Miocene volcanic rocks (12 and 28 years old) composed of basalt flows, flow breccias, pillow lavas, and some tuffs occur in moderately small pockets in the center of the San Gregorio Creek watershed and in its eastern section in an area generally immediately southwest of Langley and Mindego Hills.

Pleistocene marine and marine terrace deposits (sands and clays deposited in a period from about a half a million to one million years ago) are found concentrated in a narrow band along the Pacific coast in 28.2, from Martins Beach north, generally to just east of SR 1 and in a long narrow finger up the Purisima Creek channel. Recent alluvium (Cenozoic, Quaternary, probably within the last half million years) is reportedly found in significant strata generally in the lowest reaches of Pomponio Creek and in somewhat more extensive beds in the lower reaches of Butano and Pescadero Creeks.

Site 28 contains many small fault lines in the higher elevations in the eastern part of the Site Area. These trend northwesterly and are parallel to and southerwesterly of the large and important San Andreas Fault zone which lies just east of the eastern perimeter of the Site Area. A San Gregorio Fault line runs right through a major western part of the Site Area, roughly in a line from a point just north of the mouth of San Gregorio Creek southeasterly generally just west of Stage Road and roughly along Cloverdale Road. Some of these faults are indicated in Figure V-A-5. (Background reference Section A-3a, Refs. 2, 9.)

Summary of Hydrologic Systems and Water Quality Conditions: Site 28 is an area composed entirely of direct Pacific coastal drainage basins. Sub-Area 28.2 is dominated by the large San Gregorio Creek watershed. Other significant coastal basins include, from north to south, Canada Verde, Purisima Creek, Lobitos Creek, and Tunitas Creek north of the San Gregorio Creek watershed and Pomponio Creek south of the San Gregorio basin. Incidental coastal drainages between these are the Eel Rock, Seal Rock, Martins Beach, Mussel Rock-to-San Gregorio Beach, and two northern and small San Mateo Coastal State Beaches drainages.

Sub-Area 28.3 is composed of two large and one small distinct watersheds and three incidental coastal drainage groups. The two largest watersheds are those of Butano Creek to the north and Gazos Creek to the south. The small watershed is that of Arroyo de los Frijoles and it includes Lake Lucerne and Lower and Upper Bean Hollow Lakes. The incidental coastal drainages include the Pescadero Point-Pebble Beach area coastal drainages, the Spring Bridge Gulch-Bolsa Point-Yankee Jim Gulch area coastal drainages (north of Pidgeon Point,) and the Pidgeon Point south coastal drainages. Sub-Area 28.1 consists entirely of the Pescadero Creek watershed.

No significant groundwater basins underlie any of the areas within Site 28. The closest large ground water basin lies on the other side of the Site Area's eastern perimeter.

Estimated water quality conditions for the surface and ground waters in and around Site 28 are presented in Table V-G-1. As indicated, there is very little direct or definite data on the subject. The surface waters from generalized date (Ref. 6) appears to be generally very hard. The predominant ions reportedly are calcium, magnesium, and bicarbonate.

Table V-G-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 28

Water Quality Characteristics	Surface Waters 1/	Ground Waters 1/	Current Standards 2/
Total Dissolved Solids	340-700 mg/l	----	no numerical standards
Suspended Sediments	under 280 mg/l	----	"
Temperature (median)	60-64 °F	----	"

1. From References 6 and 7.
2. From Reference 182, for surface waters only.

b. Soils

The soils of Site 28 represent another typical complex mix of the azonal soils of mountains and geologically young mountain valleys complete with very minor amounts of partially lithosolic (stony, gravelly) soils and regosulic (alluvial) soils. They are very generally classified as non-calcic chestnut and brown type warm dry soils, with nearly black, friable, organic-rich topsoils and subsoils without any large accumulations of calcium carbonate or gypsum and only partial accumulations of clay. The mean annual soil temperature is over 47°F. There is little evidence of any significant development toward the stratification typical of the podzolic soils which are typical for the geologically older mountainous and/or coniferous forest regions (i.e., significant leaching of the surface layers under the humus top cover with a dense clayey subsurface.) The potential and/or historical natural vegetative cover for this Study Site is considered to be coastal sagebrush (Salvia-Eriogenum) at the lower elevations along the coast and California mixed evergreen forest (Quercus-Arbutus-Pseudotsuga) or broadleaf and needleleaf forest at the higher inland elevations. More detailed soil information concerning the specific identified soil associations found in Site 28 is presented in Tables V-A-2,3,9, and 10 (Ref. 10f.)

The predominant soil grouping in the Study Site is composed of acid, generally brownish loamy upland soils with generally more acidic and more clayey subsoils which have developed in sedimentary rock strata with some basic igneous rock intrusions. This soil group covers about 74 percent of the surface of the Study Site. These soils are found on the steep to very steep slopes of the mountainous uplands of the Site, the slopes almost always exceeding 30 percent. This soil grouping includes, in order of importance, the Hugo-Butano-Josephine (covering by itself about 47 percent of Site 28,) Lobitos-Gazos, Lobitos-Gazos-Santa Lucia, and Mayman-Los Gatos soil associations. The dominant soil association is composed of slightly to medium acid, pale brown granular fine sandy loams, light brownish gray and light brown granular loams, and pale brown loams in the surface layers together with medium to very strongly acid, generally subangular blocky subsurface layers composed of light brownish gray very gravelly sandy loams, pale brown clay loams, reddish yellow sandy clay loams and brown loams. Their substratum consist of fractured bedded Monterey shale at 2 to 4 feet depth, soft sandstone at 3 to 5 feet depth, and acid coarse grained sandstone at about 2 feet depth. These soils have developed on acid shale and sandstone strata and under cover of Douglas-fir, redwood, and hardwood timber. The two major secondary soil associations are composed of (1) medium acid subangular blocky soils, dark grayish brown loams in the surface layers, light olive brown gravelly clays in the subsurface layers, substratum softly consolidated sediments - 2 to 4 feet down; (2) neutral grayish brown granular silty loams over sandstone, 2 to 3 feet down; and

(3) medium acid gray granular shaly loam topsoils, with strongly acid grayish brown very shaly loam subsoils, over a shattered siliceous shale substratum at about 2 feet down. These secondary soil associations are considered to exhibit a moderate to high erosion hazard. The Sweeny-Mindego soil association is closely related to this soil grouping. It differs primarily in being less acidic, more clayey, and having developed on weathered basic igneous rock and basalt bedrock.

The major secondary soil grouping in the Site Area includes the Watsonville-Elkhorn and Tierra-Colma soil associations. They cover about 13 percent of the Site's surface and are generally found on slopes ranging from 2 to 30 percent. Their erosion hazard increases with increasing slope. They are located on the gently sloping, rolling, and hilly dissected coastal terraces. These soils characteristically have acid dark gray granular loam surface layers with acid brownish generally dense very slowly permeable clay or claypan-like subsoils. Topsoils range from sandy loams, loams, to clay loams; acidity from slight to strong. Associated subsoils range from slightly acid mottled yellowish brown blocky clays and dark grayish brown prismatic heavy clay loams, to medium acid brown to yellowish brown subangular blocky sandy clay loams and loams, to slightly acid black prismatic heavy sandy clay loams. Their substratum consist of stratified sandy loam and sandy clay loam alluvium; stratified layers of moderately fine textured coastal sediments; old sedimentary alluvium; and stratified, medium textured, weakly consolidated marine sediments.

Another significant secondary soil grouping consists of very deep well drained loamy regosolic soils exhibiting little or no increase in clay content in the subsoils. They cover about 6 percent of Site and occur on nearly level to gently sloping (0 to 5 percent) fans and low terraces along the major stream channels. These soils are in the Tunitas-Lockwood association. They are composed of medium acid very dark gray granular loams and clay loams and grayish brown subangular blocky loams and shaly loams in the surface layers; mildly alkaline very dark gray subangular clays and slightly acid light yellowish brown massive shaly clay loams in the subsurface layers; with their substratum consisting of mildly alkaline mottled fine textured sedimentary alluvium and moderately fine slightly acid fine textured shaly sedimentary alluvium derived from siliceous shales.

c. Climatology and Meteorology

The climate of San Mateo County is characterized by dry, mild summers and moist, cool winters. The mean annual precipitation for the Study Site is 39 inches with about 80 percent occuring during the months of November through March. During the winter, the moisture-laden air masses move in from the Pacific Ocean with precipitation increasing as the

air is lifted over the eastern Santa Cruz Mountains ridge. This means annual precipitation ranges from about 20 inches along the Pacific Coast to highs of over 40 inches along the ridge heights. Occasional snow falls have been experienced along the crest area. Frequent fogs envelope the entire Site area. Mean annual sunshine is about 2800 to 3000 hours per year. Temperatures are rather mild because of the Site's proximity to the ocean. Air temperatures average about 49°F in January and July, average about 58°F along the Pacific shore to highs of about 64 °F further inland. The average length of the growing season is about 280 to 300 days without a killing frost. Mean annual pan evaporation has been estimated at 54 inches with about 64 percent taking place between May and September. Mean annual evapotranspiration from non-irrigated areas varies from about 15 inches to just over 20 inches in some higher crest areas. Annual potential evapotranspiration has been estimated at 38 inches, the annual vegatative requirement at 25.1 inches (see Table V-A-4). (Refs. 2,6,10f,12.)

Summary of Air Quality Conditions: It is estimated that Site 28 currently experiences less than 5 day per year oxident levels at or over 0.10 ppm levels with this increasing up to 10 days per year in the northern and eastern portions of the Site Area. Background discussion for this has been presented in Section A-3d. The Site's proximity to San Francisco to the north and urbanized San Mateo County and San Jose to the east together with the projection of current development rates would indicate a general increase in these experiences with higher oxident levels. The degree to which current air pollution control programs, Federal, state, or local, will effect this in the immediate future period is uncertain. (Ref. 142.)

a. Vegetative Cover

Wastewater Application Site 28 (San Mateo County) supports five major vegetative cover types - agricultural, grasses and forbs, chaparral brush, hardwoods (oak parklands and mixed evergreen forest) and coniferous forest (Figure V-G-6). The agricultural areas are found in a coastal band and within the coastal valleys. Agricultural uses include pasturage, flowers, and row crops such as brussel sprouts, cabbage, and cauliflower. Large commercial pumpkin "patches" are common.

Foothill areas, east of the coastal agricultural belt, support both grasses and forbs and chaparral brush vegetative cover types. The dominant species in these vegetative cover types, as well as the other cover types on Site 28, are listed in Table V-G-2. Ravines, erosion cuts, and small streambeds in grassland areas are lined with the brush, chaparral broom (Baccharis pilularis). Some grassy hillsides appear to be reclaimed from brush. Valley areas tend to be grasslands, while hilltops (inland from the shore) tend to support brush species.

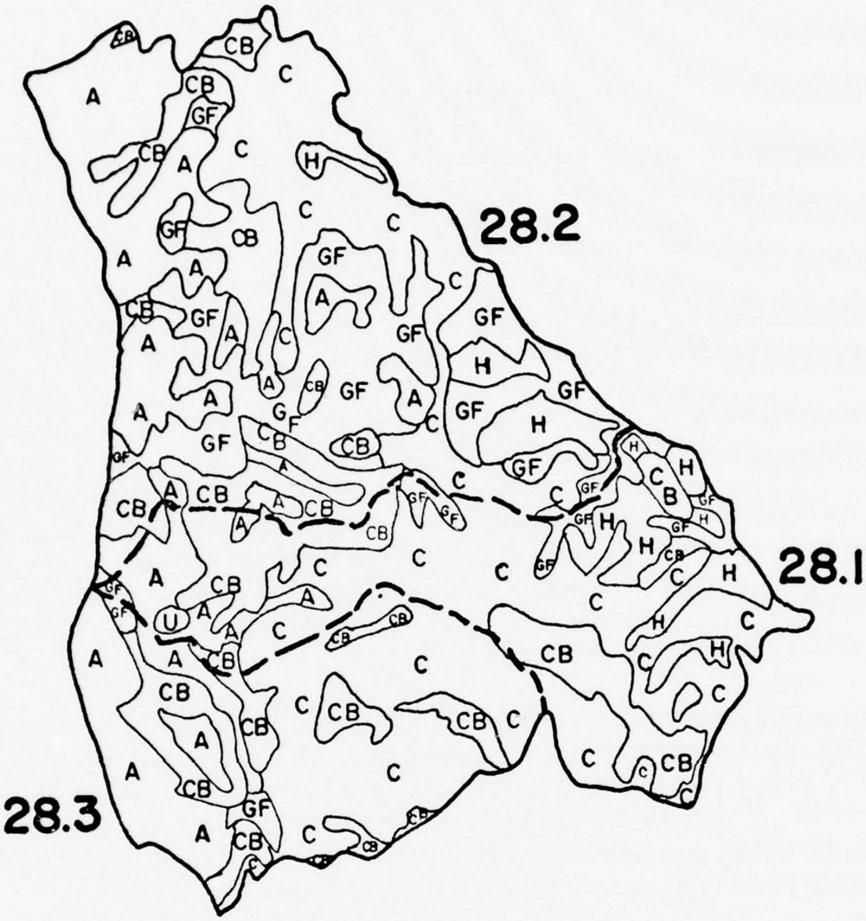
The vegetation of the upper Tunitas and Purisima Creek drainages and the Butano Forest south of LaHonda is redwood forest (Figure V-G-6). Areas of redwood forest, mixed with riparian vegetation, also extend down narrow creek valleys into the brush and grasslands near the coast. Coast redwood, Douglas fir, and tanbark oak are the major tree species that form dense coniferous type forest cover throughout the Site Area.

Integrading with the redwood forest downslope from the ridge crest (Skyline Boulevard) and at the highest elevations in the study area are found mixed evergreen forests. These forests are dominated by tanbark oak, Douglas fir, and California bay (Table V-G-2). Small areas of oak woodlands are supported on dry slopes near the crest (Skyline Boulevard) and are dominated by live oaks, California buckeye, and various grass species.

The vegetative cover map (Figure V-G-6) indicates the heterogeneity of the distribution of the area's plant association groups (vegetative cover types). With the exception of the expanses of redwood forest, the rest of the cover types are restricted to smaller non-contiguous areas. This distribution is due in part to clearing of forest and brushland by lumbering and agricultural interests. Rare, endangered, and possibly extinct plants of Site 28 are listed in Table V-G-3.

Figure V-G-6

EXISTING VEGETATIVE COVER IN SITE 28



COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous forest
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

Table V-G-2

DOMINANT PLANT SPECIES OF WASTEWATER LAND APPLICATION STUDY SITE 28

Vegetative Cover	Scientific Name	Common Name
Grasses and forbs	Festuca spp.	Fescue
	Bromus spp.	Chess
	Avena spp.	Oats
Chaparral brush	Baccharis pilularis	Chaparral broom
	Rubus vitifolius	California blackberry
	Mimulus aurantiacus	Monkey flower
Hardwoods (oak woodland)	Quercus chrysolepis	Canyon live oak
	Aesculus californica	California buckeye
	Quercus agrifolia	Coast live oak
	Q. kelloggii	Black oak
	Rhamnus californica	California coffeeberry
Hardwoods (mixed evergreen forest)	Lithocarpus densiflora	Tanbark oak
	Arbutus menzeisii	Madrone
	Pseudotsuga menzeisii	Douglas fir
	Castanopsis chrysophylla	Chinquapin
	Umbellularia californica	California bay
	Acer macrophyllum	Maple
	Quercus chrysolepis	Canyon live oak
	Q. kelloggii	Black oak
Coniferous forest	Sequoia sempervirens	Coast redwood
	Pseudotsuga menziesii	Douglas fir
	Lithocarpus densiflora	Tanbark oak
	Viccinium ovatum	Huckleberry
	V. parvifolium	Red huckleberry
Riparian	Alnus oregana	Red alder
	A. rhombifolia	White alder
	Salix ssp.	Willow
	Sambucus mexicana	Elderberry
	S. callicarpa	Elderberry
	Rubus parviflorus	Thimbleberry
	Acer macrophyllum	Maple

Table V-G-3

RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS OF WASTEWATER LAND APPLICATION STUDY SITE 28

Species*	Local Habitat	Plant Community
Chaetopappa bellidiflora	Open dry rock slopes	North coastal scrub Coastal prairie
Helianthella castanea	Grassy hillsides 500-4000 feet	Foothill woodland Valley grassland
Cupressus abramsiana (Santa Cruz cypress	Dry slopes 1600-2500 feet Bonnie Doon Eagle Rocks Santa Cruz Mountains	Yellow pine forest Closed-cone pine forest
Arctostaphylos pacifica (a shrub)	No data	Foothill woodland
Potentilla hickmanii	Rare in marshy places at scattered stations	
Castilleja latifolia	Sandy places	Coastal strand Closed-cone pine forest

*Note: Most of these species do not have common names. All but two, as indicated, are grasses or forbs.

b. Fish and Wildlife

Fisheries: The freshwater fishery of Site 28 is almost entirely located in streams. There are a few farm ponds, but are rather insignificant in terms of a freshwater fishery. The coast does provide an ocean fishery.

Anadromous Fish. San Mateo County contains 4 miles of coho salmon streams (1,000 spawners) and 111 miles of steelhead streams (8,000 spawners) in the western slope streams which flow to the ocean. A summary of the salmon (species unknown) and steelhead catch for San Mateo County in 1968 are given below:

Salmon,	
Commercial (thousand pounds)	244
Sport Salmon,	
Numbers of fish	
Ocean	1,350
River	200
Steelhead,	
River, sport numbers of fish	400

Freshwater Fishery. A resident trout fishery is present in Tunitas, Gazos, San Gregorio, Butano, and Pescadero Creeks. A warm-water fishery is not well defined in these streams; however, many of them contain non-game fish species such as carp, hitch, and suckers.

Marine Fishery. San Mateo County possesses many miles of ocean front. Fish species are diverse and numerous (the Appendix, Chapter K, Inshore fishes). Invertebrates are common in tidepools and inshore waters.

Wildlife: The coastal and foothill brush areas, particularly when associated with adjacent grasslands yield the most varied and abundant wildlife. The coastal beaches, offshore rocks, and tidepools are another source of abundant wildlife. A list of the wildlife observed and their habitat is in Table V-G-4, and a list of all wildlife found in the area is in the Appendix, (Chapter K).

Big Game. Deer are found in densities of 60 to 100 per square mile in the coastal brush and 30 to 60 per square mile in other wildlands. Forty fallow deer are known to occur in San Mateo County. (Ref. 32.)

Table V-G-4

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS
ON OCTOBER 10-11, 1972
OF WASTEWATER LAND APPLICATION STUDY SITE 28

a. Coastal Beaches, Marshlands, and Offshore Rocks

Birds	Mammals
Marsh hawk	Harbor seal
Herring gull	Brush rabbit
California gull	
Glaucous-winged gull	
Common loon	**Invertebrates**
Brown pelican	
Snowy plover	Star fish
Long-billed dowitcher	Anemonies
Western sandpiper	Mussels
Sanderling	Barnacles
Western Grebe	
Cormorant, (pelagic ?)	
Common egret	
Great blue heron	
Red-winged blackbird	
Ruddy duck	
Pintail	
Mallard	
Common coots	
Bufflehead	

Note: Wildlife are listed in the habitat type that they were most frequently observed in, or restricted to. Some animals may be commonly found in more than one area.

Table V-G-4 (Continued)

b. Foothill Brush, Grasslands, and Riparian Habitat

Birds	Mammals
Scrub jay	Opossum (Rk)
Red-tailed hawk	Raccoon (Rk)
Sparrow hawk	Brush rabbit
Turkey vulture	Columbian blacktailed deer
Mockingbird	Pocket gopher
Red-shafted flicker	
Brown towhee	
Rufous-sided towhee	
Oregon junco	
California valley quail	
Western meadowlark	
Robin	
Loggerhead shrike	
Common bushtit	
Belted kingfisher (riparian)	
House finch	
Song sparrow	
House sparrow	
White-crowned sparrow	

Rk Road kill

c. Coniferous and Hardwood Forests

Birds	Amphibians
Stellar's jay	California newt (moist redwood forests)
Chestnut backed chickadee	

Mammals	Invertebrates
Columbian black tailed deer	Banana slug (moist redwood forests)

Mountain lion and black bear probably occur in the area, but in extremely small numbers. Mountain lion are secretive and are rarely seen. No more than 3 or 4 lions would probably occur in Site 28.

Upland Game. "Good" numbers of California valley quail are found in Site 28; densities of 190 to 320 per square mile occur in most wildlands and agricultural areas. Winter densities of band-tailed pigeons are 64 to 640 per square mile in years of good feed. Doves, rabbits, and tree squirrels are common. (Ref. 32.)

Waterfowl. Site 28 has generally poor habitat for dabbling species of ducks. There are very few open water areas with adequate cover and food. Offshore waters are important resting areas for diving duck species, especially where food is available.

Pescadero Lagoon is one of the larger bodies of water in Site 28. This lagoon is important to dabbling duck species for food and cover.

Non-game Wildlife. Sea otter are relatively common on the coast of Site 28. Although at one time they were hunted to near extinction, sea otter populations have made a recovery in these waters. Harbor seals are common on tidal and inshore rocks. About 30 harbor seals were observed during the field excursions into Site 28. Other furbearers found in Site 28 include skunks, foxes, and coyotes. Shore birds and sea fowl are common on the beaches and inshore areas.

Rare and Endangered Species: Sixteen animal species listed on rare or endangered species lists are thought or known to occur in Site 28. They include one mammal, thirteen birds, and two reptiles. They are listed in Table V-G-5.

The Alameda striped racer is listed by Stebbins (Ref. 97) to occur in San Mateo County. This snake is associated with chaparral, but may occur in grassland, open woods, and rocky slopes (Ref. 36.) Habitat reduction due to development and construction has reduced its number to the level of its being considered rare. (No census data is available.)

The San Francisco garter snake is distributed from San Francisco County south to Ano Nuevo Pt. and from the coast east to the crest of the peninsula hills. It is commonly found along water and it prefers vegetation bordering lakes, ponds, and marshes. Its habitat is continually being reduced by housing development, by the construction of roads, and by the draining of marshes.

The tule white-fronted goose and the Aleutian Canada goose are winter visitors to the California coast using the lakes, bays, and marshes along the coast as resting and feeding areas, Geese are "grazers" utilizing grain, young grasses and young forbs for food.

Table V-G-5

RARE AND ENDANGERED ANIMAL SPECIES OF SITE 28

Common Name	Status	Occurrence
Reptiles:		
Alameda striped racer	R	x
San Francisco garter snake	E	x
Birds:		
Aleutian Canada goose	E	*
Tule white-fronted goose	E	*
Red-bellied red-shouldered hawk	U	*
Ferrunginous hawk	U	x
Southern bald eagle	E	x
American osprey	U	x
California clapper rail	R,E	x
California black rail	R	*
Alaskan short billed dowitcher	U	*
California least tern	E	x
Northwestern tropical kingbird	P	*
Yakutat fox sparrow	U	x
Mammals:		
Southern sea otter	R	x

E Endangered
R Rare
P Peripheral
U Status uncertain

x This species or subspecies definitely or probably occurs in the Site area.

* Occurrence of this species or subspecies in the Site area is uncertain or questionable

Pesticide accumulation has been indicated as a cause in the decline of several species of raptorial, fish eating, birds. The American osprey, American peregrine falcon, southern bald eagle and the brown pelican among the rare and endangered birds have suffered reproductive failures associated with chlorinated hydrocarbons. Other sources leading to the decline of the southern bald eagle include shooting by irresponsible persons, destruction of nesting sites, and human encroachment of feeding areas. The American peregrine falcon has been taken illegally by falconers for many years.

The California clapper rail and the California black rail are dependent upon salt marsh land for their continued existence. The California clapper rail is a very specialized bird apparently incapable of adapting to environmental change. Landfill, diking, and drainage of marshes and the introduction

of the old-world rat threatens its continued existence. The current status of the California black rail is not presently known. Historically it occurred in limited numbers in salt water marches from Tomales Bay south to Baja California. Destruction of salt marshes threatens the existence of this species.

The California least tern is a summer visitor to the California coast. It breeds from Baja California to San Francisco Bay on sandy beaches. Predation and human disturbance are important factors in the decline of populations of this species.

The southern sea otter was once seriously overharvested; but its numbers are now increasing. The sea otter inhabits kelp beds and rocky shores, feeding on abalone and sea urchins. Small populations occur along the central and northern California coast.

Wildlife and Fish Diseases:

Wildlife Diseases. Deer inhabiting the coastal areas north of Monterey Bay are afflicted with a wide variety of internal parasites. Two of the more commonly encountered endoparasites which are extremely detrimental to deer occur on Site 28; they are lungworms and stomach worms. Environmental factors are important in the production of overwhelming parasite burdens in the animals. Moisture favors development of the eggs into larval stages and survival of the larvae until they are ingested. Another factor is the interrelation between nutrition and resistance. Deer utilizing abundant high nutritional food develop an immunity to worm parasites and are able to live with low worm numbers. The conversion of chaparral to redwood forests on Site 28 would destroy the forage required by deer. Application of wastewater for irrigated pastures adjacent to the forest would furnish the larvae a requisite environment for survival. These conditions could result in increased deer mortality on Site 28.

No other wildlife diseases of significance are present or are anticipated relative to the application of wastewater on Site 28.

Fish Diseases and Parasites. The fish diseases and parasites found in Site 28 will be essentially the same as those found in Site 4. Diseases that afflict coho (silver) salmon could have serious consequences on the coho salmon populations that spawn in the coastal streams of Site 28. For other diseases refer to the discussion on fish diseases and parasites found in the present environment section of Site 4.

c. Ecological Systems

The small coastal streams (Gazos, San Gregorio, Butano, and Pescadero) and their lagoons are important waterways for coho (silver) salmon and steelhead. Clean gravel beds free of silt are necessary for successful spawning of salmon. Coho salmon young spend a little over one year (a few spend two years) in freshwater before migrating to the ocean. High summer temperatures are critical factors for young salmon fry. The optimum temperatures range for salmon eggs and fry is from 48°F to 55°F, and for downstream migrant salmon it is from 52°F to 68°F (68°F critical thermal maximum). Salmon and steelhead eggs already deposited in the streams must remain free from siltation; otherwise they will be suffocated and will not hatch.

Dissolved oxygen (DO) must remain high for salmon and steelhead in all life stages:

Salmon and Steelhead life stages	Optimum O_2 sat.	Approx. min. O_2 requirement in mg/1*
Upstream migrants (adult)	75-100%	8.5
Eggs and fry	90-100%	10.2
Downstream migrants	75-100%	8.5

* Figures based on a DO of 11.3 mg/l at equilibrium with air, 50°F at sea level.

Tide pool and intertidal communities occur along the coast in Site 28 from Franklin Point north: Tide pool organisms have adapted to the strong currents and tidal action in many ways; one way is to firmly attach to the substrate and lead a relatively sedentary life. Mussels, barnacles and anemonies remain firmly attached throughout their adult life. Some tide pool fish, such as gobies, have developed "suction cup" like ventral fins to keep them attached to the substrate during tidal activity. Other tide pool invertebrates such as crabs and starfish are mobile but may be relatively restricted to one area.

Tide pools are influenced by local environment conditions, such as tidal action, duration of exposure, and water quality. They are easily preyed upon at low tides by birds and mammals, including man.

Coniferous forests habitat are found throughout Site 28 in the inner coastal mountains and especially in the Butano Forest in the southern part

of the Area

The canopy of coniferous forests provides habitat for many bird species, such as warblers and vireos. Other birds occur in the ground level depending upon the amount of brush occurring on the ground level. Black bear are common, but not abundant in these forest areas.

In general, the greatest diversity of life is found on or just below the ground layer in a forest. Small mammals such as shrews, mice and moles live in the humus layer along with numerous invertebrates. Any change in the diversity or abundance of these animals may affect the life of predators that utilize these small mammals and invertebrates. A change in the humidity and temperature of the forst floor may alter the species composition of the animals and plants that live there.

In the coastal foothill areas, there are areas of grasses and forbs interspersed with chaparral brush areas. These provide excellent habitat for small game animals and songbirds. Quail and brush rabbits are abundant in the "edge" cover created by the interface between brush and grassland area. Songbirds are common on the brushy fence rows in areas adjacent to grassland.

These "edge" areas are important wildlife habitat since they bring together two different biological communities, creating an area with more variety in food and cover for wildlife. Any change in the environment that tends to create a monoculture in plants will allow only those wildlife species capable of living in that particular plant community to be supported.

The marshes and lagoons found in Site 28 are critical wildlife habitat. Pescadero, Gazos, San Gregorio, Pomponio and Butano Creeks have small lagoons at their openings into the ocean. These lagoons provide resting and feeding areas for migrant waterfowl and they provide homes for resident shore and wading birds and marsh associated mammals. Water flows are critical factors in these coastal lagoons. A reduced freshwater flow will allow increased salt water intrusion into the lagoon. Water salinity will affect the species composition of marsh plants, invertebrates, and fish found in the lagoons. This may affect the water birds and waterfowl using the marsh.

d. Recreational Resources

With a gross recreational user potential of 109 million visitor days per year available and a wide assortment of public parks, Site 28 receives heavy recreational use. Fishing includes salmon, steelhead and warmwater

species in additon to marine fishes. Deer, quail, doves, rabbits and tree squirrels are popular hunting game. In addition, there are plentiful sites for camping, picnicking, hiking, swimming, horseback riding and wildlife observation.

Present Public Facilities: The major public recreation facilities in Site 28 are Bean Hollow State Beach, Butano State Park, Pescadero State Beach, Pomponio State Beach, San Gregorio State Beach,' Portola State Park, and Memorial Park. They are shown in Figure V-G-2 and briefly described in Table V-G-6.

Small portions of Big Basin Redwoods State Park are included along the southern edge of Site 28. A list of the park's facilities and attendance is shown in Table V-G-7. Pebble Beach State Beach, one of the San Mateo Coast State Beaches, was not listed in the previous report. It is a small park located between Pescadero and Bean Hollow State Beaches. Its activities and facilities are similar to the other state beaches. McDonald County Park is another addition to the public recreation sites list. This park has remained undeveloped and is used primarily for youth group hiking and camping trips. Limited parking sites are available.

There are two county recreation sites along Skyline Boulevard. Redwood Park, immediately west of Huddart Park, contains 86 acres of Redwood Forest and is at present undeveloped. Spring Ridge Picnic Area is a rest stop and picnic site on Skyline Boulevard approximately 3 miles east of Highway 84.

Present Private Facilities: Private recreational development in Site 28 is extremely varied. However, only limited information on these developments is readily available. The San Francisco Y.M.C.A. Camp located in Site 28 is shown in Figure V-G-2 and briefly described in Table V-G-6.

Table V-G-6

EXISTING PUBLIC AND PRIVATE RECREATIONAL FACILITIES OF SITE 28

	Area in Acres	No. of Picnic Units	No. of Parking Units	No. of Camping Units	Miles of Trails	Recreation Visitor-Days Recent	Recreation Visitor-Days Year 2000 Projection
Public							
Bean Hollow State Beach	100	25					
Butano State Park						50,500	85,700
Pescadero State Beach	300	25					
Pomponio State Beach	100	10					
San Gregorio State Beach	200	10					
Portola State Park	1,700	106	104	60	74	147,800	251,000
San Mateo County Memorial Park		290	500	144	2	253,500	440,700
Private							
San Francisco YMCA	900					500	800

(From Table II-G-1, Vol. II, pg. G-4)

Table V-G-7

RECREATIONAL FACILITIES OF BIG BASIN REDWOODS STATE PARK (11,522 acres)*

Activities	
Camping	x
Picnicking	x
Swimming	
Riding - hiking	x
Sightseeing	
Boating	
Skiing	
Hunting - fishing	

Facilities	Units
Camping	260
Picnic units	158
Parking	150
Trails (miles)	35

Attendance	Days	Overnight
1969	745,600	119,081
1980	902,249	144,088
1990	1,100,744	175,787
2000	1,265,856	202,155

* Adapted from Refs. 28 and 39

Oakland Y.M.C.A. has a similar but smaller camp immediately east of Memorial Park. The remaining private developments are described in Table V-G-8.

Hunter and Angler Use: Hunter use figures for San Mateo County and the Santa Cruz herd section of the South Bay Wildlife Management Unit are the only figures closely applicable to Site 28. Results of the 1970 California Department of Fish and Game Hunter Survey are as follows:

1970 Hunter Survey - San Mateo County

	Bag	Hunters
Pheasant	5,200	400
Quail	9,300	1,000
Dove	25,500	1,100
Pigeon	2,200	500
Jack rabbit	500	200
Cotton tail	14,500	1,300
Tree squirrel	800	100
Ducks	13,000	700
Geese	100	100
Coots	400	100
Deer	- 0 -	500

Although no deer kills were recorded by the 1970 hunter survey, a field check of the Santa Cruz herd which ranges into San Mateo County revealed a three-year average (1969 - 1971) take of 270 from that herd (Ref. 34). The percentage of this kill taken from San Mateo County is not known.

In 1971, the Department of Fish and Game reported 200 salmon and 400 steelhead landings from San Mateo County streams (Ref. 37). Most of these fish were taken from Pescadero Creek which is listed as a Class III steelhead stream in the California Protected Waterways Plan. An estimated total of 1,400 angler days a year are spent fishing for salmon in San Mateo County resulting in a 0.14 fish per angler day yield. The steelhead figures are 3,500 angler days and a 0.11 fish per angler-day yield for the same area (Ref. 32).

Open Space: Site 28 is zoned almost entirely as open space according to the Parks and Open Space Element General Plan for 1990 produced by the San Mateo County Regional Planning Committee and accepted by the San Mateo County Board of Supervisors. The exceptions are urban space at Pescadero,

Table V-G-8

PRESENT PRIVATE RECREATIONAL DEVELOPMENT IN SITE 28 AREA

Name	Location	Known Activities Facilities
+Kings Grove	1,200 acres of redwood grove on upper Tunitas Creek	Nature preserve with cabins
The Mountain Camp	South fork of Gazos Creek	Cabins
Redwood Glen Baptist Camp	Adjacent to Memorial Park on Pescadero Creek	----
Bay Area Optimist Club - Boysville	San Gregorio Creek 1 mile west of McDonald Park	Summer camp
LaHonda Park	LaHonda	Camping, fishing
Troutmere	San Gregoria Creek immediately north of McDonald Park	Fishing
Bald Knob Sportsman's Club	Upper Purisima Creek	----
*Tunitas Beach	Tunitas	Fishing
*Martins Beach	One mile north of Tunitas	Fishing, surf netting, cabins
*Miramontes Beach	Two miles south of Half Moon Bay	Fishing, surf netting
*Purisima Creek Beach	Mouth of Purisima Creek	Fishing, surf netting
*Pigeon Point	Two and one-half miles south of Bean Hollow State Beach	Fishing, abalone picking, skindiving
*Gazos Creek Beach	Mouth of Gazos Creek	Fishing (limited public assess)

+ From Ref. 99
* Adapted from Ref. 31

San Gregorio, LaHonda, south of Half Moon Bay along State Highway 1, and along State Highway 35 north of Tunitas Creek Road.

The county has subdivided open space into several categories that reflect land use and ownership. Site 28 is dominated by general open space. This category includes public and private agricultural lands, forest and woodlands. Smaller units are designated parks and beaches, including both public and private current and proposed facilities. The smallest open space units in Site 28 are as follows: private institutions - Y.M.C.A. and youth group camps, church camps, and corporate owned recreation sties; nature preserves - 250 acres of marshland at the mouth of Pescadero Creek; and water - all lakes, ponds, marshes and reservoirs in the area. San Mateo County is actively seeking to preserve the open space value of its coastal lands in the face of urban expansion. Through programs of outright acquisition, purchase in less than fee, restrictive zoning, and modified taxation and assessment, the county is implementing its open space policies.

Future Public Facilities: San Mateo County has developed a detailed plan for expansion of its present parks and recreation sites. Their scheduled 1970 - 1979 acquisition plan includes the following: Redwood Park expansion to a total of 589 acres to act as an addition to Huddart Park; mid-coast beaches expansion to a total of 496 acres to include all beaches between mid-Half Moon Bay and Purisima Creek; south-coast beaches expansion to a total of 310 acres to include several beaches between Lobitos Creek and Pigeon Point; Bean Hollow Lakes expansion to a total of 3,280 acres to extend along Arroyo de los Frijoles and Butano Creek to Butano State Park; McDonald Park expansion to a total of 188 acres to add flatland for intensive general recreation development.

To supplement the planned parks and scenic highways, the county is developing a system of riding and hiking trails that will parallel virtually all of the major roads within Site 28 and also penetrate presently inaccessible parts of the redwood forests. Development of the trail system is being carried out jointly by the state, the county, and the cities involved.

e. Protected Waterways Status

The following waterways in Site 28 are classified in the Protected Waterways Plans.

Pescadero Creek is classified as a Class III steelhead stream in the fisheries evaluation. Pescadero Marsh is classified as Class I lagoon and an extraordinary wildlife waterway.

Class III lagoons include Gazos Creek, Pomponio Creek, San Gregario Creek and Tunitas Creek. New Year's Creek Pond (location unknown) is a Class III freshwater pond.

San Mateo County submitted the following waterways in Site 28 to be considered in the California Protected Waterways Plan: Pescadero Creek and Lagoon, Bear Hollow Lakes, Pomponio Creek, Gazos and Tunitas Creek.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

It has been estimated that the potential archaeological sites are few and scattered and would be located near the drainage channels of the Study Site(Ref. 11.) No archaeological surveys of the area have been reportedly conducted.

Site 28 contains four California Registered Historical Landmarks (Ref. 15). All of them are associated with the Portola Expedition of 1769. Number 22 is the site of a camp on the south bank of Purisima Creek the Expedition made on October 27, just opposite an abandoned Indian village on the north bank. This site is located in the general vacinity of SR 1 (Ocean Shore Road, or the Coast Highway) and Purisima Creek in Sub-Area 28.2. Landmark Number 23 is the site of a camp the Expedition made near the mouth of Gazos Creek on October 23. This site is reported located in the general vicinity of SR 1 and Gazos Creek (Sub-Area 28.3). Landmark Number 26 is the site of a camp the Expedition made at an Indian Rancheria on San Gregorio Creek on October 24 "about one-half league" from the mouth of San Gregorio Creek. This site is located "opposite" the intersection of SR 84 (La Honda Road) and Stage Road in the community of San Gregorio (Sub-Area 28.2). Landmark Number 375 is the site of an Indian village discovered by the Expedition of Tunitas Creek. The site is the southwest corner of the Rancho Canada de Verde y Arroyo de la Purisima, a Spanish land grant granted to Jose' Maria Alviso in 1838. This site is located in the general vicinity of Tunitas Beach and the mouth of Tunitas Creek (Sub-Area 28.2).

The San Mateo County Plan, in addition, indicates quite a number of historic sites and structures being cited for acquisition and/or restoration within the Study Site. In Sub-Area 28.2, 9 are located along Purisima Creek Road, 3 along Tunitas Creek Road, 1 along the Lobitos Creek Cutoff road, and 6 along the north-south leg of upper La Honda Road; one is near the north end of San Gregorio Beach, another is near the coast northwest of the community of Tunitas, and five are in or near the community of San Gregorio; 7 are located near the stream channels in the upper watershed area of El Corte De Madero Creek and 3 similarly in the uppermost watershed areas of Harrington Creek (both being tributaries of San Gregorio Creek.) In Sub-Area 28.1, the Pescadero Creek watershed, 1 is located along Stage Road, 9 along Pescadero Road, and 1 along Alpine Road; 4 are located in or near the community of Pescadero; and one each is located near the stream channels of Peters and Slate Creeks on the north side of Portola State Park. In Sub-Area 28.3, one is located near the upper end of Canyon

Road (north of ButanoState Park,) one along or near the channel of Little Butano Creek within the Butano State Park, 5 along Gazos Creek Road, and 2 near the mouth of Gazos Creek.

b. Scenic Locations

None of the waterways in Site 28 have been designated as scenic under the California Protected Waterways Plan. However, many of the small stream valleys in the Study Area are quite scenic, particularly those of Tunitas, Pescadero, and San Gregorio Creeks. The combination of riparian vegetation and redwood forest in areas with little or no obvious human encroachment provides a unique experience. The value of these scenic resources are increased significantly by their proximity to the heavily populated San Francisco Bay area. Also, the San Mateo County coast is a scenic resource of equivalent value to that officially designated as such in Site 18. (Refs. 30, 60, 86, 87.)

The California Division of Highways through their State Scenic Highway System has recognized and sought to preserve this scenic potential throughout Site 28. SR 35 (Skyline Boulevard) running along the eastern perimeter and the highest uplands of Site 28, has been designated as a scenic route. Further additions to the scenic highway system are proposed. Both state and county agencies have recognized the need to preserve additional sections of Site 28 for their scenic value. SR 9 and SR 236 along the Study Site's southeastern perimeter are scheduled for inclusion in the State Scenic Highway System; the coast highway, SR 1, is similarly scheduled for inclusion. The master plan of San Mateo County is much more extensive. The county's proposed scenic highway system consists of approximately 100 miles of proposed parkways and about 225 miles of proposed scenic highways, with Skyline Boulevard being the basic scenic trunk route. Most are proposed to have parallel or near adjacent hiking and riding trails. Scenic parkways are proposed for alignments all along Skyline Blvd., and Tunitas Creek, Cloverdale, Gazos Creek, and Pidgeon Point Roads; all along Pescadero Road east of the community of Pescadero; all along Pomponio Creek Road with extensions west to SR 1 and east to Pescadero Parkway; all along Alpine Road with western one-third relocated somewhat southward; all along Portola State Park Road with a southerly extension to a new Skillman Parkway; and a new Skillman Parkway aligned just south of Pescadero Creek and running between the Pescadero Parkway easterly to SR 236. It is proposed to make scenic highways of all of SR 1, and Lobitos Creek and La Honda Roads; almost all of Stage Road; all of Pescadero Road west of the community of Pescadero together with an easterly extension along a new alignment north of the Pescadero Parkway and joining it almost with its intersection with the existing Alpine Road;

and all of Purisima Creek Road from SR 1 to Higgins Purisima Road.

These scenic values are somewhat marred at present by the near universal appearance of roadside refuse scattered all along the edges of the Site Area's many roads, major and minor, and which are concentrated particularly at natural and specifically provided stopping and pull-off viewing areas. The universal "indicator" of this is the beer can.

Some idea of the scenic values of Site 28 can be anticipated in some of the views presented in Figures V-G-5a, 5b, and 5c.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX - THE PUBLIC HEALTH IMPLICATIONS OF LAND APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact of wastewater land application would be the loss of vegetation, wildlife habitat, and wildlife on spoil areas. The change in species association, the loss of wildlife, loss of wildland and the loss due to spoils is similar; the specific changes in species are different.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 14 for Site 4 (Section B-6o).

b. Impact 2

The second impact would be the loss of wildlife species through loss of habitat (lands, vegetation) to general project facilities.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 5 for Site 4 (Section B-6e).

c. Impact 3

The third impact would be the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilitities, maintenance roads, and above-surface distribution systems.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 4 (Section B-6L).

d. Impact 4

The fourth impact would be a change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 5 (Section C-6L).

e. Impact 5

The fifth impact would be the change in the micro-climate caused by the increased available moisture.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 4 for Site 5 (Section C-6d).

f. Impact 6.

The sixth impact would be the TDS buildup in soils that receive treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 7 for Site 5 (Section C-6g).

g. Impact 7

The seventh impact would be the reduction in the water quality of water recovered from surface, subsurface and ground waters.

Discussion: The estimated recovery water Table V-A-7 contains several components which could degrade the water quality of Site 28: total nitrogen (TN), total phosphorous (TP), and total dissolved solids (TDS).

TDS	Surface	Groundwater and Subsurface
Existing water	340-700 mg/l	No figures available
Recovery water	400-1000 mg/l	800-2000 mg/l

The projected recovery water TDS levels exceed present conditions known for Site 28. Exact water quality objectives are not available for the small coastal streams in San Mateo County, although recovered wastewaters would have to meet the general objectives of the California Regional Water Quality Control Board for the San Francisco Bay Region as spelled out in their Interim Water Quality Control Plan. TDS of over 1,000 mg/l is also suspected of interfering with the reproductive capacaties of some fish species (Centrarchids, Cyprinids and possibly salmonids).

Total nitrogen levels higher than 1 mg/l and phosphorous levels above .1 mg/l generally encourage noticeable growths of algae. Waters which are rich in nitrogen and phosphorous can have algal "blooms" of such magnitude that fish and other aquatic animals may be damaged by associated sags in available oxygen (oxygen used by the living and decomposing algae).

Dissolved oxygen levels are especially critical to salmon and steelhead populations. Optimum DO levels for trout and salmon fisheries are as follows (see page G-23).

Salmonids	Oxygen Saturation	Approximate DO in ppm*
Adults	75-100%	8.5
Eggs and fry	90-100%	10.2
Fingerlings	75-100%	8.5

(*Figures based on a DO of 11.3 mg/l at equilibrium with air, 50°F, and sea level.)

Coastal streams with anadromous fish runs (Pescadero, Gazos, Purisima, Tunitas, and San Gregorio Creeks) may develop oxygen blocks, limiting upstream migration and spawning.

Small amounts of nitrogen (under 1 mg/l) and phosphorous (under 0.1 mg/l) could beneficially affect these coastal streams by increasing primary productivity, but larger amounts could cause serious "algal blooms."

The significance of this impact rests on information to be gathered during design and from more detailed and specific environmental studies.

Remedial, Protective and Mitigation Measures: Application zones should be limited to those watersheds that provide maximum chances for dilution and mixing.

Application should be altered seasonally to enhance chances for successful anadromous fish spawning and rearing.

Monitoring of all outflows from a site to a stream will be necessary to control the water quality of streams. High TDS, TN and TP waters may required pre- or post-application treatment to prevent degradation of surface or ground waters.

h. Impact 8

The eighth impact would be an increase in stream turbidity caused by increased runoff:

Discussion: Application of wastewater to Site 28 may increase stream turbidity through several mechanisms. Applications that substantially increase in-channel flows may stimulate bank cutting and slumping, especially in areas with either poor riparian growth or unstable soils. The lower stretches of Pescadero, Gazos, Butano and San Gregorio Creeks and smaller streams

draining the grassland foothills along the coast may be subject to this accelerated stream bank erosion.

Wastewater applications covering large land parcels through sprinkling, misting or gravity flow will decrease soil water carrying capacity. As a result, rainfalls of relatively small volume will fill remaining pore spaces and stimulate overland and sheet flow, resulting in increased movement of soil particles. The overgrazed pastureland of Site 28's coastal strip and inland valleys (San Gregorio Creek, Pescadero Creek and Butano Creek Valleys) may be especially susceptible to accelerated overland flow and resulting increased stream turbidity and sedimentation. Application in areas previously logged or in redwood forest areas with little ground cover may also stimulate sheet and gully erosion.

Increase in stream turbidity may cause siltation of stream gravels necessary for the successful spawning of anadromous fish. Silting leads to suffocation of eggs. Turbid conditions above 30 Jackson Turbidity Units (JTU) also hinder the feeding success of sight-feeding fish (trout, steelhead) and fishing.

The soils in Site 28 are very susceptible to erosion as observed during field investigations of this site. A heavy rain occurring on Site 28 during field investigations caused streams in this area to become excessively silty. The erosion problem in this area is site specific.

<u>Remedial, Protective and Mitigation Measures:</u> Application should be restricted to areas with sufficient ground cover to retard sheet erosion.

Increase ground cover in application zones by seeding, terracing, composting, mulching and fertilizing.

Restrict application rates to levels that would not stimulate sheet or stream bank erosion.

Provide seasonal freshwater flood flows that are sufficient to flush silted sand and gravel deposits and maintain pool-riffle relationships.

i. Impact 9

The ninth impact would be a possible increase in surface water temperatures.

<u>Discussion:</u> Application of wastewaters either directly or indirectly to stream channels may increase the temperatures of existing flows. The level

of increase would depend upon temperature of wastewater prior to application, time lag for cooling between application and entrance into stream, volume of application, volume of stream flow, vegetative cover, local climatological conditions, and actual stream termperature.

Wastewater exposed to the sun for long period of time (irrigation of row crops or pasture) may increase the temperature of streams receiving surface or subsurface drainage of wastewaters. Subsurface waters may increase in temperature if they are constantly infiltrated by wastewater of higher mean temperature. This water eventually drains into streams and thereby may raise the mean water temperature of streams.

Optimum temperatures for trout and salmon fisheries are as follows:

Trout

Summer - 45-68^{O}F
Winter - 42-58^{O}F

Salmonids

Migration routes - 45-68^{O}F
Spawning areas - 45-55^{O}F
Rearing areas - 50-68^{O}F

Any wastewater application that would increase stream temperatures beyond these optimum figures would be detrimental to existing coldwater fisheries. Most warmwater fisheries will not tolerate temperatures in excess of 90^{O} F.

Remedial, Protective and Mitigation Measures: Restrict input water temperatures of coldwater streams to levels within optimum trout and salmonid requirements.

Limit wastewater application to drainages without important trout and salmonid populations.

Export recovery waters from drainages with important trout and salmonid populations.

j. Impact 10

The tenth impact would be a loss of recreation opportunities and potential due to a reduction in water quality.

Discussion: Reduction in existing water quality may degrade the quality of recreational opportunities found in Site 28. Water contact sports popular along the San Mateo coast (surfing, scuba diving, swimming, surf fishing) are dependent upon the quality of in-shore waters. Also, inland fishing on Pescadero, Purisima, Tunitas, San Gregorio, Gazos, Butano and numerous smaller creeks will fluctuate with the water's ability to support healthy resident and anadromous fish populations. Water quality parameters important to fish life and subject to degradation by wastewater application include TDS, TP, TN, turbidity, temperature and other site specifc factors.

TDS greater than 1000 ppm has been known to inhibit the reproductive capacities of some fish (Centrarchids, Cyprimids, and possibly salmonids). Elevated TDS may change plant communities to less desirable species. Sometimes frothing of the turbulent salt waters occur and cause unsightly conditions. Excessive levels of two biostimulants, nitrogen (over 1 ppm) and phosphorous (over 0.1 ppm) could lead to serious "algal blooms" which may cause sags in available dissolved oxygen. Turbidity above 68° for any sustained period of time may be deterimental for young salmonid fishes in coastal streams.

Wastewater application zones may be removed from general public use for health as well as psychological reasons. Physical contact with sprayed, misted or ditch spread wastewater could create a health hazard and is also psychologically undesirable. Application on or near state, county or private parks is therefore undesirable. Use of present and proposed equestrian, hiking and biking trails throughout Site 28 may be curtailed for the same health and aesthetic reasons.

Reduction in water quality may result in loss of hunting opportunity due to increased disease in game species.

This impact is significant in Site 28.

Remedial, Protective and Mitigation Measures: Monitor lands and water courses that are receiving recovered wastewater to control and keep water quality within public health water contact specifications and requirements needed to maintain present fisheries and wildlife populations.

Maintain a buffer strip of non-application around state beaches and parks, county parks and all private recreational areas.

k. Impact 11

The eleventh impact would be a reduction in value of scenic areas.

Discussion: Construction of permanent above-ground wastewater delivery and dispersal systems along well-traveled scenic roads and trails and in scenic park areas would be a detriment to aesthetic and recreational values. Especially sensitive areas would include present and proposed scenic highways (State Highways 1, 35, 9 and 236), proposed county parkways and hiking trails, and all state, county and private parks.

Remedial, Protective and Mitigation Measures: Delivery and dispersal systems for wastewaters should be located away from roadways, trails and popular recreation sites.

Planting of roadside trees and shrubs would mitigate the undesirable scenic effects of delivery and dispersal systems clearly visible from roads.

L. Impact 12

The twelfth impact would be the introduction and encouragement of wildlife diseases from wastewater applications.

Discussion: Wastewater application along grassland-chaparral borders that turn dry grazing land into permanent pasture may stimulate endoparasitic infection in deer herds. Stomach worm and lungworm populations increase with increased moisture. Deer frequenting the grassland-chaparral borders would be subject to increased infection by these parasites. Mixed evergreen-chaparral borders are also favored deer areas and may be subject to the same infestations.

Artificially ponding wastewater or introducing wastewater into present marshes and lakes may increase the incidence of avian cholera and botulism by increasing the amount of habitat available to ducks. These two diseases are seasonally present amont California waterfowl populations and the intensity of outbreak is associated with population density. Of special concern are the lagoon and marsh areas at the mouths of Pescadero Creek, Pomponio Creek, San Gregorio Creek and Gazos Creek. Lake Lucerne, the Bean Hollow Lakes and numerous small farm ponds around San Gregorio and Pescadero may also be affected.

Remedial, Protective and Mitigation Measures: Monitor wastewater pre- and post-application to prevent the introduction of disease organisms.

Restrict wastewater application to areas outside popular deer range.

Effective management of stream flows carrying wastewater into lakes and marsh lands could diminish the threat of avian cholera and botulism by seasonally flushing the areas.

m. Impact 13

The thirteenth impact would be the augmentation of summer stream flows.

Discussion: Seasonal application of wastewaters could increase present summer stream flows. Providing water quality is maintained at acceptable levels, summer survival of resident and anadromous fish populations could be enhanced. Application in intermittent stream drainages may open more streams to permanent fish populations.

This action would have a beneficial impact.

n. Impact 14

The fourteenth impact would be an increase in gamebird numbers.

Discussion: An increase in water available for farming may expand intensive agricultural practices into areas presently unused or only grazed. Row and field crops would supply habitat for pheasant, quail and dove if properly managed. The hillsides along lower Pescadero, Butano, San Gregorio and Gazos Creeks are examples of areas capable of supporting increased gamebird populations if better cover and feed were available. Management and maintenance of edge cover along fences, canals, roads and planned plots or corridors would increase the habitat significantly. See Fig. V-G-3.

This action would have a beneficial impact.

o. Impact 15

The fifteenth impact would be the generation of unpleasant odors.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 21 for Site 5 (Section G-5a). The increase in mosquitoes, etc. with the addition of water is similar, not the lands.

p. Impact 16

The sixteenth impact would be an increase in gnats and midge populations.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for [illegible] (Section G-[illegible]).

q. Impact 17

The seventeenth impact would be the possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 15 for Site 4 (Section B-6o).

r. Impact 18

The eighteenth impact would be the introduction of fish diseases and parasites into new areas by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 4 (Section B-6p).

s. Impact 19

The nineteenth impact would be the increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 17 for Site 4 (Section B-6q).

t. Impact 20

The twentieth impact would be an increase in stress factors of fish and their relationship to the susceptibility of fish to disease and parasitism.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of this topic under the long-term impacts in Site 18, Impact 24 (Section D-6x).

u. Impact 21

The twenty-first impact would be an increase in fish diseases because of higher water temperatures of recovered wastewater and increased bacterial growth.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of this topic under the long-term impacts of Site 18, Impact 25 (Section D-6y).

v. Impact 22

The twenty-second impact would be a possible disruption in the life cycle of steelhead and salmon fishes because of a change in the water quality due to the addition of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 26 for Site 18 (Section D-6z).

w. Summary of Sensitive Areas

Figure V-C-1 delineates the location of environmentally "sensitive" areas in Site 28. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

The "sensitive" areas of Site 28 consist of: (1) Purisima, Lobitos, and Tunitas Creeks in Sub-Site 28.2, (2) San Gregorio Creek and some of its major tributaries in Sub-Site 28.2 together with the San Gregorio Beach recreational area in the vicinity of its mouth, (3) Pomponio Creek in Sub-Site 28.2 together with the Pomponio Beach recreational area in the vicinity of its mouth, (4) Pescadero Creek and some its major tributaries in Sub-Site 28.1, Pescadero Marsh, together with the Pescadero Beach recreational area in the vicinity of the mouth of Pescadero and Butano Creeks mouth and Pescadero Marsh, (5) Butano and Gazos Creeks, Arroyo de los Frijoles, Bean Hollow Lakes, and Lake Lucerne in Sub-Site 28.3, (6) six recreational areas; Butano State Park in Sub-Site 28.3, Portola State Park, San Mateo County Memorial Park, and the Oakland and San Francisco Y.M.C.A. areas in Sub-Site 28.1, and Sam McDonald Park straddling Sub-Sites 28.1 and 28.2, (7) the coastline all along the western perimeter of Site 28, (8) the proposed scenic highway, SR 1, all along the coastline, and SR 35 (Skyline Blvd.) and SR 9 all along the eastern perimeter of the Site and (9) coniferous forest areas in the northeastern quarter of Sub-Site 28.2, along the upper part of San Gregorio Creek and along La Honda Creek, in the southern and southeastern part of the Pescadero Creek basin (Sub-Site 28.1,) and in the eastern half of Sub-Site 28.3.

SECTION H

H. WASTEWATER LAND APPLICATION SITE 42: SOUTHEASTERN CONTRA COSTA COUNTY AREA

1 - Project Development

a. Present Land Uses

Site 42 covers a major portion of southeastern Contra Costa County and projects into the northeasternmost corner of Alameda County. It lies east of Mt. Diablo, generally west of the Southern Pacific Railroad and SR 4, south of Lone Tree Way and Contra Costa's Suisun Bay and Sacramento-San Joaquin Delta front communities, and north of the northern drainage limits of the Livermore Valley. A southeastern bulge projects into a south-central section of the legally defined Sacramento-San Joaquin Delta, specifically into Clifton Court, up to the west bank of the San Joaquin River's Old River (and the Contra Costa-San Joaquin County line.) This southeastern bulge (Sub-Area 42.3) contains major elements of the California State Water Project (Clifton Court Forebay, the Delta Pumping Plant, Bethany Reservoir, and small canal elements of the California Aqueduct) and the U.S. Bureau of Reclamation's Central Valley Project (Tracy Pumping Station, and small elements of the Delta-Mendota Canal.)

Antioch is located 3 miles to the north of the Study Site, Concord 8 miles to the northwest, Walnut Creek 8 miles and Oakland 20 miles to the west, Livermore 7 miles to the southwest, Tracy 8 miles to the southeast, Stockton 23 miles to the east, and Sacramento about 45 miles to the north northeast. The small communities of Brentwood and Byron lie just outside the eastern perimeter. The eastern perimeter of Site 42 is provided by the Southern Pacific Railroad; Lone Tree Way providing about half of the northern perimeter. The remainder of the northern perimeter is along a low ridge line running southwesterly toward Mt. Diablo and separating areas of Site 42 which drain toward the east from areas to the north which drain northward toward Suisun Bay. The western perimeter is a continuation of this ridge line; it runs through the two peaks of Mt. Diablo and separates the easterly draining areas of Site 42 from those areas in central Contra Costa which drain westerly and subsequently northerly into Suisun Bay. The southern perimeter is a further continuation of this ridge line; it runs through the Black Hills and Windy Point peak and subsequently southeasterly through Brushy Peak; it separates Site 42 from areas of Contra Costa and Alameda Counties which drain into the Livermore Valley and subsequently westerly into South San Francisco Bay. The perimeter around the southeastern bulge is provided by a small unnamed stream which winds around Bethany Reservoir to Mountain House Road; subsequently Mountain House Road, Kelso Road,

Byron Highway, a road just west of the Alameda-San Joaquin County line, the Old River (the Contra Costa-San Joaquin County line,) West Canal, and finally Clifton Court Road and an easterly extending line across Clifton Court. Use Figures V-H-1 and V-B-2 for location reference.

Site 42 occupies about 107,600 acres. For study purposes, it has been divided into 4 sub-areas as shown in Figures V-B-2 and V-H-1. These sub-areas and their areas are as follows:

Sub-Area No.	Sub-Area Designation	Area in Acres
42.1	Deer Valley	2,000
42.2	Upper Marsh Creek	27,000
42.3	Clifton Court Forebay	13,000
42.4	Lower Marsh Creek, Kellog and Brushy Creeks	65,000

Agriculture is the predominant land-use in the lower and more level parts of the Study Site. Row crops and orchards are predominant in the flat eastern part of Sub-Area 42.4 while pasture or range lands predominate in higher valley flatlands and low hills of central and southern 42.4, and in Sub-Areas 42.1 and 42.3. Wild lands occupy the higher and steeper elevations, particularly along the higher ridges and in the canyons that lead from the valleys to Mt. Diablo. The Site has a moderately extensive system of roads, particularly in the eastern flatlands. Residential land-use is scattered along these roads and in somewhat more concentrated form in the eastern flatlands and particularly around the outskirts of Brentwood and Byron. Some concentrated recreational land-use is located along Marsh Creek and Morgan Territory Roads in the general vicinity of their intersection (along with the Contra Costa Correctional Facility.) Projected future land-use indicates the spreading of residential development throughout the eastern flatlands and recreational land-use all along Marsh Creek and Morgan Territory Roads and completely enveloping the Marsh Creek Reservoir area.

A Kellogg Reservoir is being proposed for the lower Kellogg Creek just southeast of the existing Marsh Creek Reservoir. It is intended to be a water supply project and has been under study by the U.S. Bureau of Reclamation and the Contra Costa Water District. There is no authorized plan at the present time, but it has been discussed in connection with the total State water resources development. The Marsh Creek Reservoir is a flood control project sponsored by the Contra Costa County Flood Control District.

The Contra Costa County Water Quality Study (Ref. 9) considered, as one of the alternatives for the central and eastern parts of the County, transporting the water to the east and treating it for disposal in the Delta

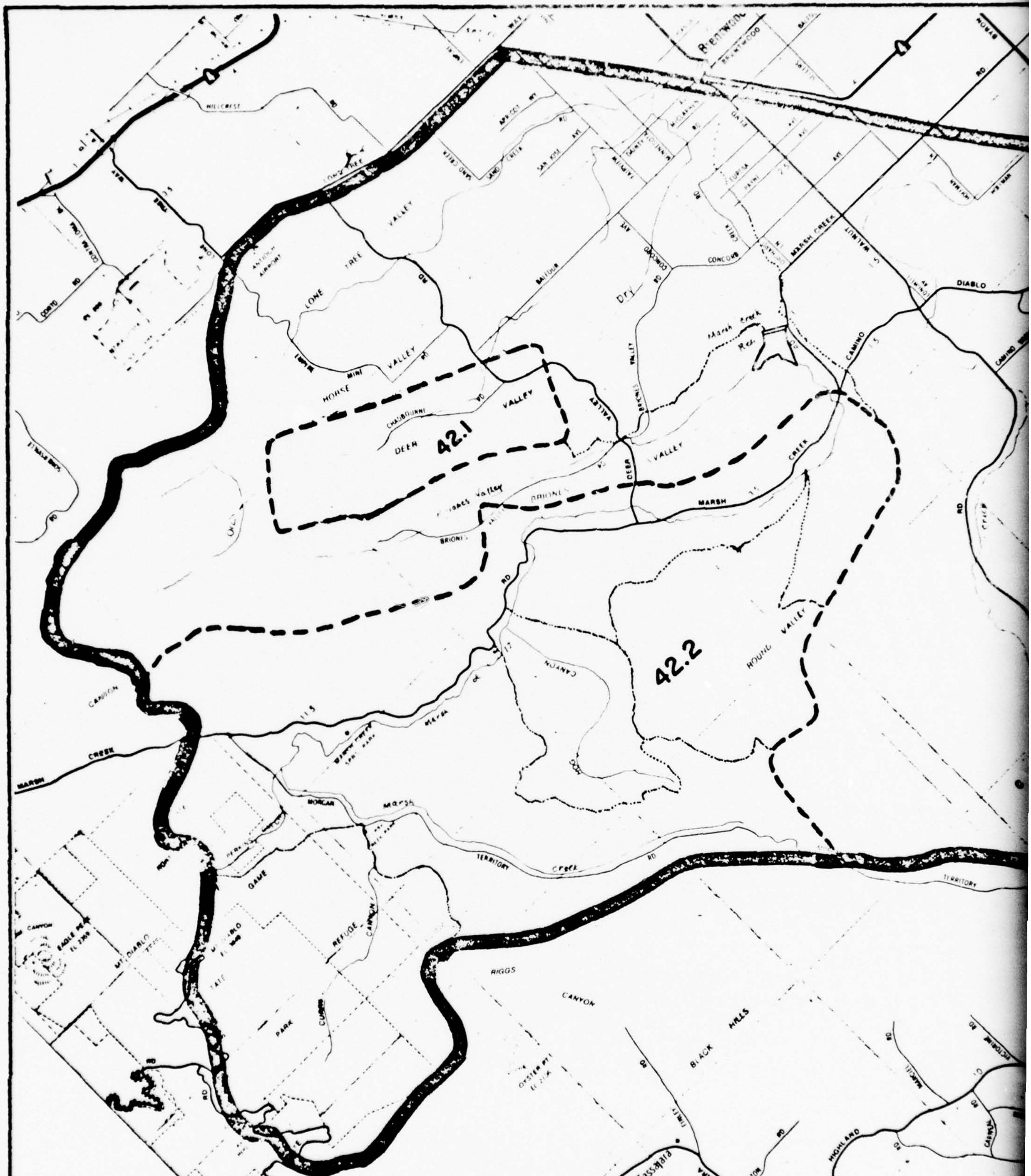


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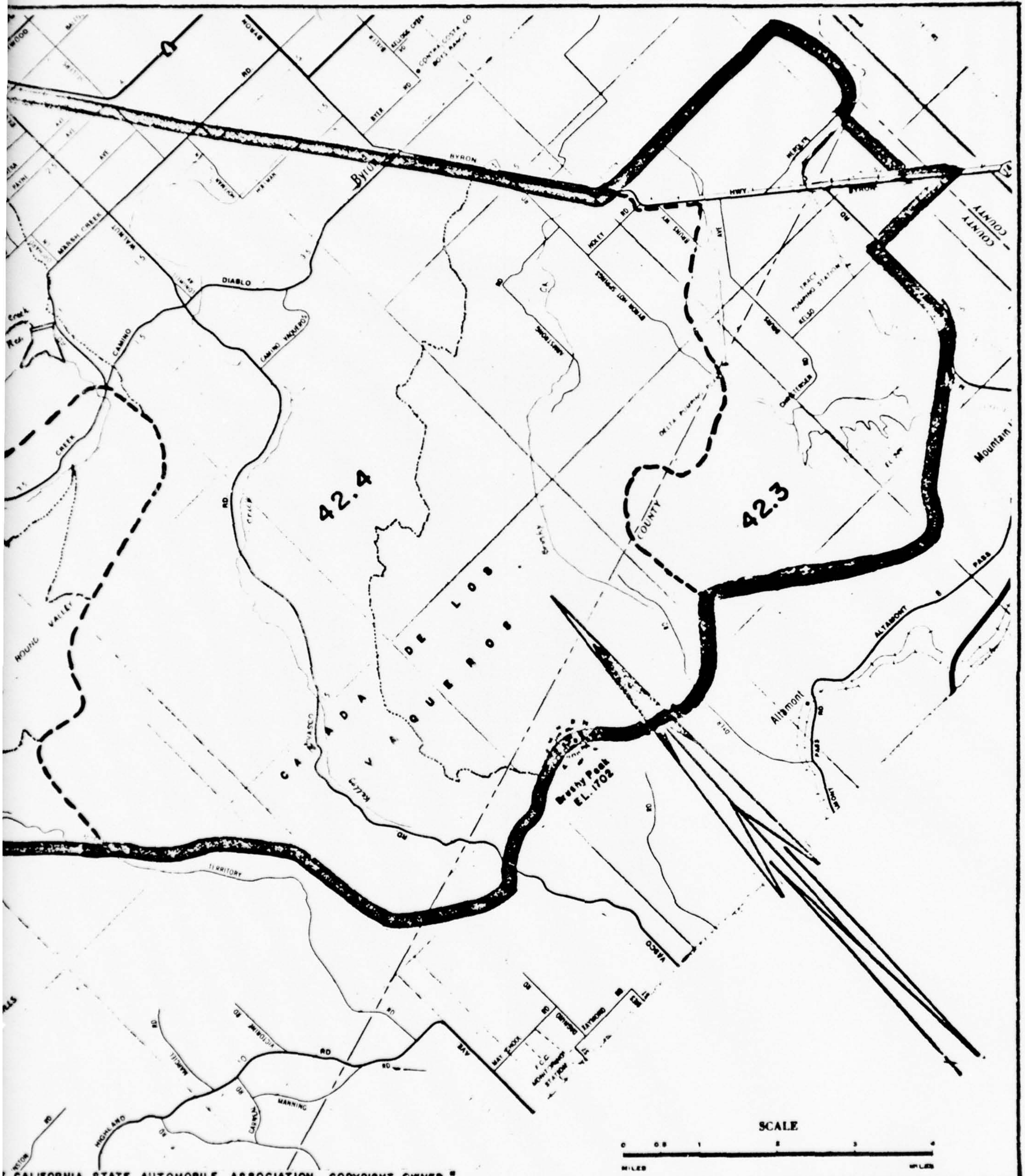
Figure V-H-1


42.4
42.3
CAÑADA DE LOS VAQUEROS
Brushy Peak EL. 1702
Altamont
Mountain
BYRON HWY
DIABLO
CAMINO
ROUND VALLEY
TERRITORY
VASCO
ALTAMONT PASS
TRACY PUMPING STATION
MANNING
HIGHLAND
SCALE
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area and, therefore, it required high levels of treatment to remove all toxicants and biostimulants. The alternative included ponding for tertiary treatment with ultimate use for irrigation or for discharge into the Suisun Bay estuary to assist in salinity repulsion (i.e., to increase freshwater outflow.)

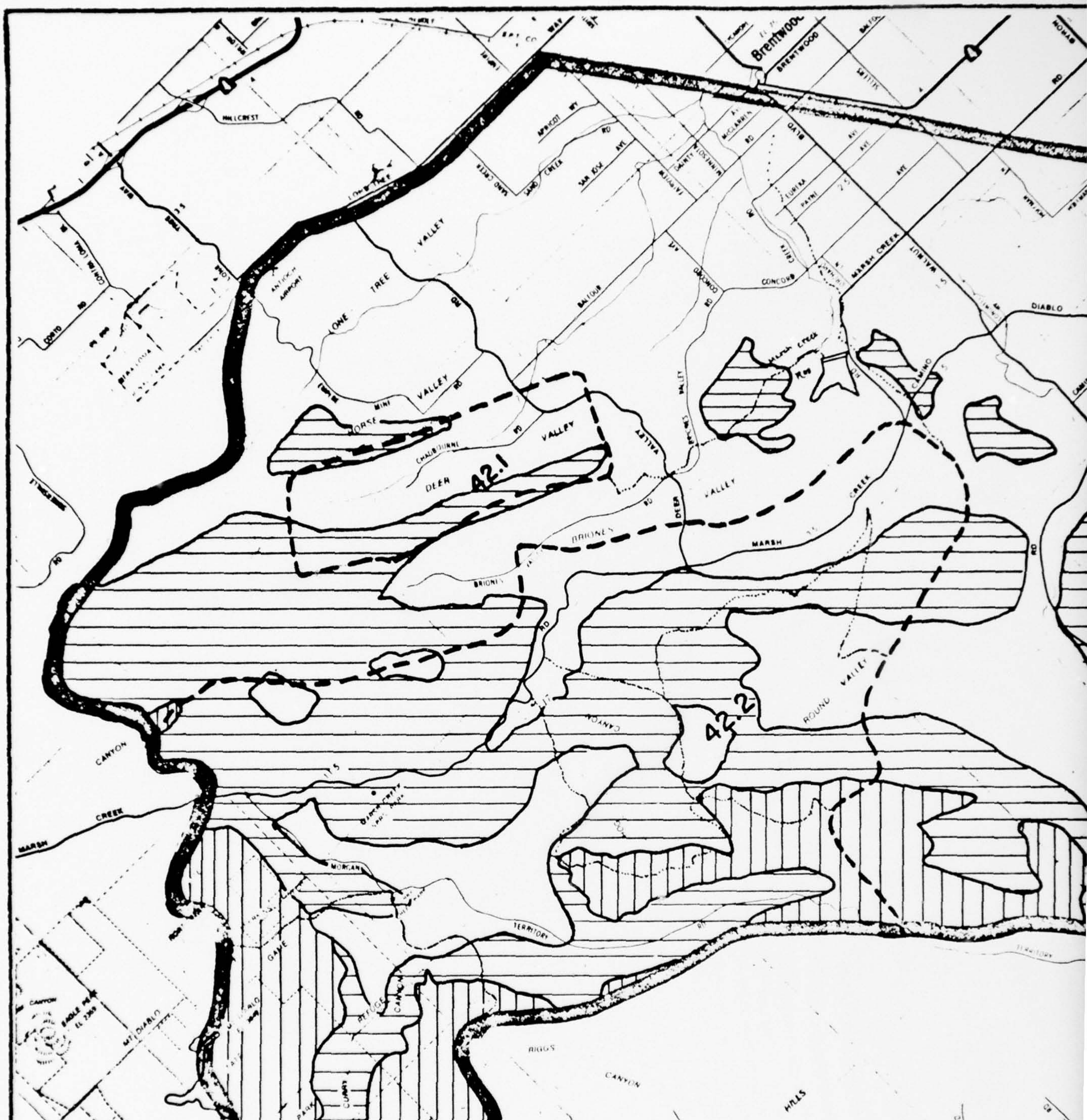
Recent demands by the California State Water Resources Control Board for early water pollution abatement action by industries in the Antioch area has caused considerable work by the individual industries. There is interest in a subregional water quality management plan that encompasses more eastern areas of Contra Costa County than that encompassed in the first stage plan proposal of the Brown and Caldwell study (Ref. 9.) This plan proposed to begin at the Antioch bridge and extend westward to include the City of Antioch. The California Regional Water Quality Control Board for the Central Valley Region is concerned with the treatment facilities of the cities of Oakley (2.5 miles north northeast of the Site Area's northeast corner) and Brentwood and desires some system to upgrade these plants, preferably to combine them into a central facility.

b. Development Objectives

Site 42 is reasonably representative of potential sites situated in the innermost parts of the Coast Range immediately adjacent to the Central Valley flatlands and of potential sites in the immediate periphery of the Sacramento-San Joaquin Delta. It is also reasonably more representative of areas close to substantial urban development. The Site offers opportunities for development of recreation and open space areas, forest lands, and wildlife habitats. With adequate wastewater treatment, there are additional possibilities for direct delivery of effluents to the Clifton Court Forebay for use in either the California Aqueduct or the Delta-Mendota Canal. There is also special concern for water quality in the Site Area relative to the reservoir on Marsh Creek and the proposed reservoir on Kellogg Creek.

There are several special factors that must be taken into consideration in Site 42, and these concern the Clifton Court area as a forebay for both the State Water Project and the Central Valley Project. The quality of any wastewater drainage that could enter the forebay must be given careful consideration because this forebay is a freshwater supply "depot" for the two projects under the Peripheral Canal concept for a cross-delta facility.

Proposed land uses and types of land applications based on soil capabilities are shown in Figure V-B-3. This figure and Figure V-H-2 also show areas which were excluded because of excessive elevation (over 1500 feet.)



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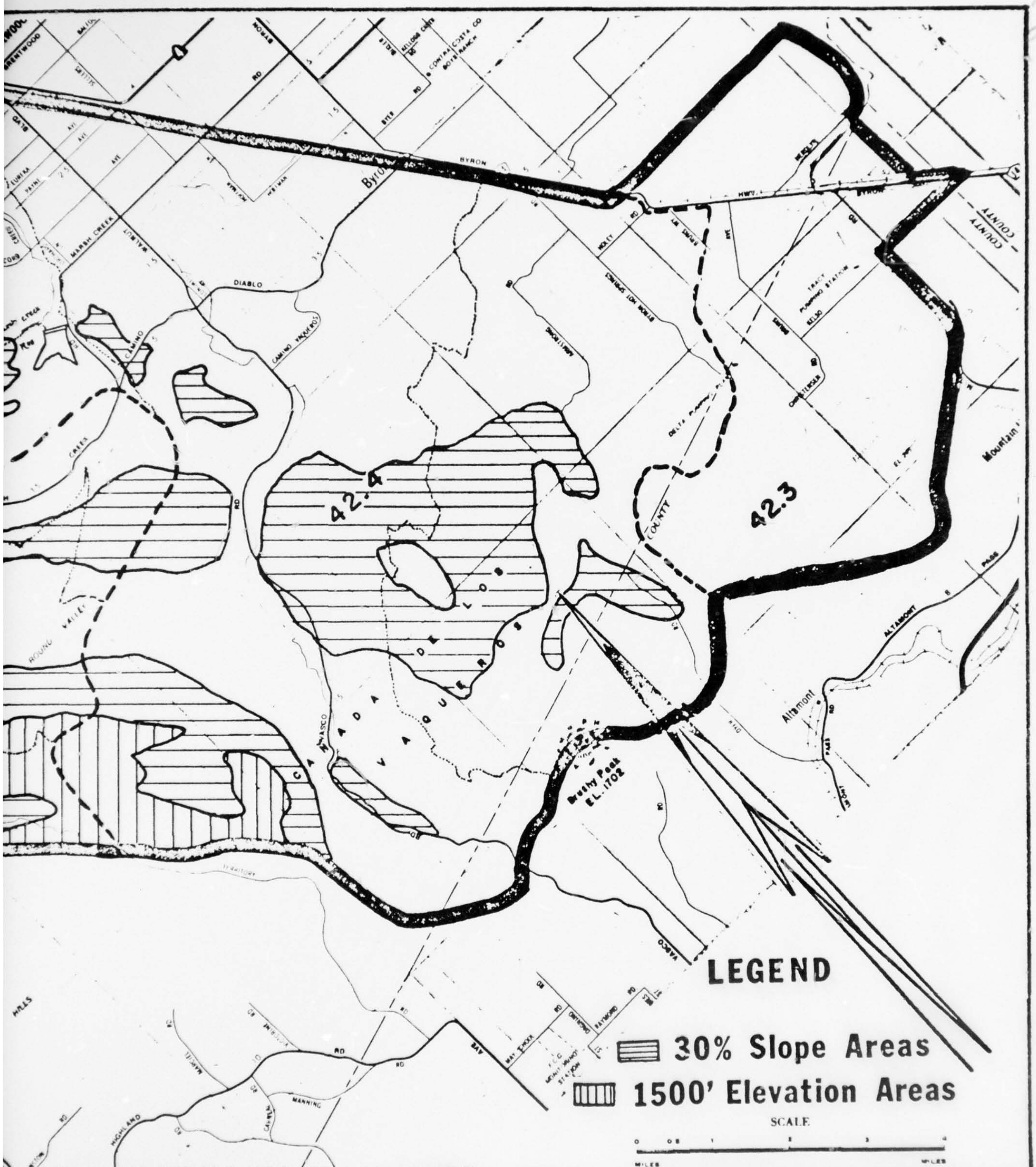

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Areas with slopes over 30 percent predominating have been delineated in Figure V-H-2. These latter areas are being considered for exclusion because of increased possibilities of erosion and landslides. These areas have been delineated as a result of onsite inspections and subsequent topographic map analysis. Recommended unit application rates for the proposed and potential land uses are presented in Table V-A-6. The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10. The areas most suitable for wastewater land application are located primarily in the eastern two-thirds of the Site.

The possible sources of wastewater for land application to parcels in Site 42 and the possible combination of them will depend upon the degree and extensiveness of the regionalization in the collection and treatment of wastewaters thought advisable. The possible sources include the Delta front cities (Pittsburgh, Antioch, Oakley, etc.) to the north; the central Contra Costa County cities (Concord, Walnut Creek, Clayton, Martinez, etc.) to the west and northwest· the communities of the Livermore Valley (Livermore, Pleasonton, etc) to the southwest; Brentwood and Byron on the eastern perimeter; perhaps also in more extensive systems Contra Costa County's San Pablo Bay and Carquinez Straits fronting cities (Richmond to Crocket) to the northwest. Stockton to the northeast, and the Oakland-Berkeley area to the west. These treated wastewaters can be brought into the Site best along a few of the major and minor roadways that cross its various perimeters. The quality of the applied wastewaters can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of the various possible wastewater sources indicated above. The estimated quality of recoverable wastewaters is that presented in Table V-A-7.

The distribution and recovery systems will follow the management and development outlines presented in Sections A-7a, b, and c. The general conveyance of wastewaters into Site 42 will range from slightly downhill to slightly uphill depending upon the various possible sources of these wastewaters. It is therefore expected that the distribution system will be designed, in part, much like that of many water supply distribution systems complete with pressure zones to minimize pumping. Conveyance to the southeastern flatlands of Sub-Area 42.4 and the flatlands of 42.3 will be slightly downhill regardless of the sources of possible wastewaters. Conveyance to the interior valley flatlands of Site 42 from sources in the Livermore Valley would be generally downhill while those from other possible sources would range from about level to somewhat uphill. In any case, conveyance of wastewaters into the Site has to surmount some significant increases in elevation enroute. The most direct route from the Antioch area (to the north) is along Lone Tree Way; the lowest elevation encountered being 175 feet. About 160 feet is the lowest elevation through the hills just northwest of the intersection of Hillcrest and Lone Tree Way. These can be avoided, however, by

an "end-run" swing along the Southern Pacific Railroad entering the Site's northeast corner at an elevation of about 95 feet. From that point south, conveyance is downhill; to the west and southwest it is uphill. The lowest elevation along the western perimeter occurs at the crest of Marsh Creek Road, about 956 feet. The lowest elevations along the long southern perimeter occur at the crests of Vasco and Dyer Roads, about 950 and 800 feet respectively. These entry points would provide the most direct access for wastewaters from the Livermore Valley in the southern part of Sub-Area 42.4. Conveyance form the Livermore Valley to Sub-Area 42.3 would encounter the lowest elevation in the Altamont Pass (just under 800 feet) which is located just south of the southern perimeter of 42.3; any conveyance line in all probability then swinging around to Mountain House Road. From this foregoing analysis it is clear that all the land application sites in the valley flatlands and most in the rolling foothills could be served by a gravity system from sources coming from the west and southwest in view of the necessary pumping involved.

It is expected that major distribution lines within the Site will be along the roadways. Laterals can branch off at selected elevations at the higher entrance points to many of the valley areas and subsequently follow these elevation lines around the valley perimeter for purposes of gravity distribution. One principal distribution line will be along the eastern perimeter and it will probably be a pressure line. Laterals will branch off and project up the various valley lowlands following the general pattern discussed in Section A-7c for the Capay Valley. Laterals in the eastern flatlands can follow the near gridiron pattern of this section's road system and/or tie into the already existing irrigation works.

The recovery of applied wastewaters through sub-surface systems will be concentrated in the eastern flatlands of 42.4 and 42.3 where existing crop cultivation is proposed for continuation and through existing facilities. The pasture lands and forest lands can, for recovery purposes, use small constructed catchments or impoundments on the many small tributary drainage channels which serve these areas together with pumping facilities to convey away such waters as may require post-treatment or which can be directly re-used.

Site 42, somewhat like Site 5, projects into two of the Study Regions's geomorphic provinces; (1) the Central Valley province, particularly its southern segment - the San Joaquin Valley, covering the eastern one-third of the Study Site, essentially the flatlands east of the Marsh Creek Reservoir; and (2) the Coast Range province, specifically its inner range zone, covering the western two-thirds of the Study Site. Elevations range from -7 feet in Clifton Court (Sub-Area 42.3) in the extreme southeastern corner of the Site to 3849 feet at Mt. Diablo on the western perimeter.

The Coast Range portions of the Study Site are only 20 to 50 percent gently sloping, with over 75 percent of the gentle slopes being in the lowlands. This is characteristic of most of the Coast Range from the lower Russian River drainages to Santa Barbara County. This western two-thirds of this Study Site is composed of two generalized physiographic regions; (1) the uplands consisting of the gentle-to-steep sloping, smooth rolling hills and fairly rugged small open mountains of the Diablo Range, with elevations ranging between about 300 feet to just under 2600 feet, Mt. Diablo (3849 feet) and North Peak (3557 feet) being the singular exceptions; and (2) the small intermountain valley lowlands, generally youthful and V-shaped, and consisting of nearly level flood-plains and low terraces with gently rolling fans and old terrace remnants adjacent to the uplands. Most of the valleys slope from west to east with elevations generally under 300 feet and are separated from one another by ridges generally under 1000 feet. This Coast Range sector of the Site is enclosed in part by a ridge line, beginning near the northern perimeter at about 400 feet elevation, which runs generally higher up to the peaks of Mt. Diablo and then southeasterly and genrally downward to Brushy Peak at elevation 1702 feet. This low mountainous area is part of the northernmost elements of the great Diablo Range, an inner coast range which lies between the southern part of the San Francisco Bay de the Santa Clara Valley, and the upper part of the Salinas Basin to the west and the San Joaquin Valley to the east.

The Central Valley portions of the Study Site consist primarily of flat alluvial fans and floodplains which are more than 80 percent gently sloping, a characteristic of the Central Valley. The exception to this is the irregular plains and tablelands generally lying west of the flat plains and concentrated in the western part of Sub-Area 42.3 and the southern part of 42.4 immediately north of 42.3. The Sacramento-San Joaquin Delta can be considered a distinctive physiographic region of the Central Valley. It consists primarily of alluvial deposits lying between a maze of meandering major and minor river and stream channels. These low-lying river-delta lands have largely been reclaimed through the use of protective dikes. The southernmost part of the central hydrographic division of the Delta lies just east of the Site's

entire eastern perimeter and projects into the northern part of Sub-Area 42.3. For all paractical purposes, this Delta area in 42.3 can be considered everything north of the Byron Highway.

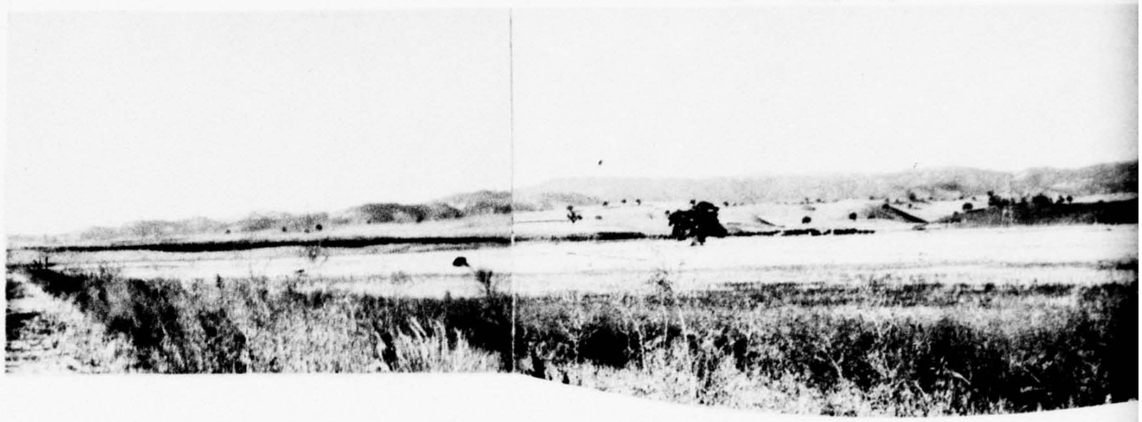
Figures V-H-3a, 3b, and 3c show some typical views of the Site.

a. Geology and Hydrology

Summary of Geology: The oldest subsurface strata in Site 42 is composed of the sedimentary and meta-sedimentary rocks of the Franciscan Assemblage. This strata is considered to be the "basement" formation in the area and to be of Jurassic and possibly pre-Jurassic age (i.e., Mesozoic Era, 130 to 155 million years old, perhaps more.) (Ref. 9.) It is composed of graywacke, locally abundant red and green thin-bedded chert, siltstone and silty shale, minor conglomerate, limestone, blue-gray glaucophane-bearing schist and related metamorphic rock; it is concentrated in the western section of Sub-Area 42.2 on the upper western slopes of Curry Canyon and all around Mt. Diablo and North Peak.

The most extensive subsurface strata in Site 42 is composed of upper Cretaceous (late Mesozoic, 60 to 100 million year old) marine sedimentary rocks; brittle silty shale, minor interbedded sandstone, and local limestone lenses. It is the predominant formation underlying the entire central and southern part of the Site Area; essentially everything east of Morgan Territory Road and south of a curved line running from the headwaters of Oil Creek, along the north ridge line of Briones Valley, through the Marsh Creek Reservoir, and then southeasterly through the Bethany Reservoir. Associated with this formation is the undivided Cretaceous (Mesozoic, 60 to 130 million year old) marine sedimentary rock strata composed of undifferentiated sandstone mudstone, minor conglomerate, white procelaneous shale, limestone, and tuff. It is located in a triangular wedge between the previous two identified formations; i.e., in Curry Canyon-upper Marsh Creek area of Sub-Area 42.2.

The remainder of Site 42 is underlain with Cenozoic sedimentary and meta-sedimentary rock strata (under 60 million years old.) The most extensive of these is the Eocene (Tertiary period, 40 to 50 million year old) marine sedimentary rock formation. It is composed of highly fossiliferous sandstone and conglomerate and predominates in the highest elevations of the western two-thirds of the southern perimeter ridge line of Sub-Area 42.2 and in all but the valley flatlands of Sub-Area 42.1 (Deer Valley) and northwestern 42.4 (i.e., generally west of a line from Hillcrest and Lone Tree Way to Marsh Creek Reservoir and north of the Briones Valley.) The other important Tertiary formation is composed of upper Miocene (12 to 20 million



1. Panorama at Balfour and Fairview Roads in Dry Creek Drainage of
Notable Landmarks from Right to Left (W to S) Mt Diablo, Black H
Canada de los Vaqueros on H

2. View WSW at Briones Valley Dr of Upper Marsh Creek Water Shed with Marsh Creek Reservoir in Foreground and Mt Diablo on Horizon

3. Also Along Reservoir Dam

4. Panorama at High Point on Camino Diablo Road Upper Marsh Creek Reservoir

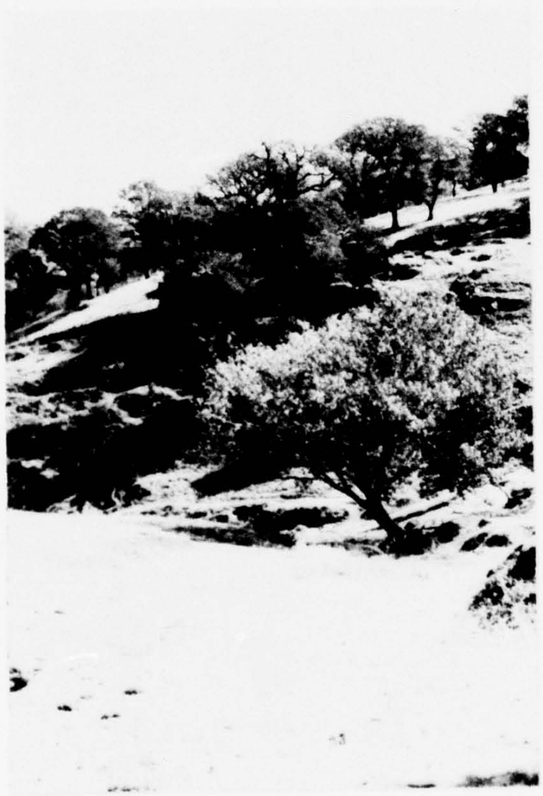
Site 42

s in Dry Creek Drainage of Lower Marsh Creek Water Shed
W to S) Mt Diablo, Black Hills and the Hills of the
nada de los Vaqueros on Horizon

Also Along Reservoir Dam and Looking NW toward John Marsh House Historic Landmark

5. SSW View Up Kellog Creek Valley at Vasco Rd with Kellog Creek in foreground and the Canada de los Vaqueros Hills on Horizon

6. Clifton Court



7. Typical View Up N Slopes of the Canada de los Vaqueros

8. Mine and Slag Pond on Morgan Territory Road Just S of Marsh Creek Road Intersection

Site 42

6. Clifton Court Forebay Lower Left Taken at Clifton Court Road

Slag Pond on Morgan
oad Just S of Marsh
d Intersection

9. Deer Valley Looking W from Deer Valley Road about a half mile in from Marsh Creek Road

10. House of Dr. John Marsh Historic Landmark

12. Typical View in E Contra Costa County of
Cultivated Fields and the Hills of the Can

Site 42

ark

11. Italian Slough N on Clifton Court Road 1 mile
W of Byron Road

in E Contra Costa County of the Rolling Hills,
ields and the Hills of the Canada de los Vaqueros (Ref. 19)

year old) marine sedimentary rocks; blue andesite sandstone and comglomerate, white quartzose sandstone and claystone, and massive conglomerate sandstone. It is located in a 5 mile long northwest trending band in the low rolling hills just west of Byron and just south of Marsh Creek Road. An equivalent band of the Eocene rock strata is located just west of it. The most extensive Quaternary subsurface stratum is composed of recent alluvial fan deposits of the Great Valley; brown to gray sand and silt deposited within the last half million years during the flood stages of major streams in the area between natural stream levees and fans. This stratum underlies all the flatlands just west of the eastern perimeter of Sub-Area 42.4 and extends up the lower channel zones of Sand, Deer, Dry, Marsh, and Kellogg Creeks. Pleistocene (0.5 to 1 million year old) non-marine sedimentary deposits of brown to gray locally pebbly sand and minor silt and clay are concentrated in the flatlands in the central part of the Lone Tree Valley and along a band parallel to most of Lone Tree Way. They also predominate in the flatlands of Sub-Area 42.3 (its northern third) and extends northwesterly in the Flatlands of 42.4 to just beyond Brushy Creek. Recent stream alluvium (under 0.5 million year old) deposits predominate in the flatlands of Horse Valley, Deer Valley, Briones Valley, the floodplain of Marsh Creek for about 6 miles above Marsh Creek Reservoir, Round Valley, and the floodplain of Kellogg Creek for about 6 miles upstream of Camino Diablo Road.

Site 42 contains a number of small fault lines. The two most significant ones are the more-or-less northwest trending Diablo Fault (in the general vicinity of and along Morgan Territory Road) and the Greenville Fault in the general vicinity of the southern perimeter of Sub-Area 42.2.

Summary of Hydrologic Systems and Water Quality Conditions: Site 42 is an area composed entirely of lands draining into the Delta. Most of the Site Area is within the Marsh Creek watershed; this includes all of Sub-Area 42.1 and 42.2 and the north-northwestern part of 42.4. Marsh Creek drains into the eastern end of Big Break, located just northeast of Oakley and south of Jersey Island, near the confluence of the San Joaquin River with the Sacramento River. The major tributary channels of Marsh Creek within the Site Area are Sand Creek-Oil Creek, Deer Creek, and Dry Creek below the Marsh Creek Reservoir (all in the northern part of 42.4) and the Briones Valley creek above the reservoir (and essentially sandwiched in between Deer Valley (42.1) and Sub-Area 42.2. Sub-Area 42.2 encompasses the entirety of the upper Marsh Creek watershed, the watershed of Marsh Creek above the Marsh Creek Reservoir.

The Kellogg Creek watershed within Site 42 encompasses the central "neck" and southwestern quarter of Sub-Area 42.4. Kellogg Creek drains into Indian Slough at a point about 4 miles northeast of Byron. The Brushy Creek watershed within Site 42 encompasses the southeastern "quarter" of

Sub-Area 42.4. Brushy Creek drains into Italian Slough at a point on the west side of the Clifton Court Forebay (just north of the northern perimeter of Sub-Area 42.3.) Sub-Area 42.3 is not part of any easily definable drainage; but the area generally would drain naturally into Clifton Court. The stream flows in the Site are intermittent and many of the stream valleys are highly eroded due to the movements of cattle.

The extensive groundwater basin of the Central Valley lies just east of the Study Site's eastern perimeter. Elements of this groundwater basin project into Site 42 all along its eastern and southeastern perimeter; under all the flatlands in the lowest reaches of Kellogg and Marsh Creeks (above Byron) projecting up the Marsh Creek channel to the Marsh Creek Reservoir, into the lowest reaches of Dry and Deer Creeks, and up the Sand Creek channel almost to Deer Valley Road; it projects only in a narrow band westerly of the Southern Pacific Railroad in the general vicinity from Byron south to Clifton Road and under most of the flatlands in Sub-Area 42.3 (its northern one-third.) Major projections of this groundwater basin lie north and west of the Study Site; under the whole western Delta and the eastern part of Suisun Bay, projecting under the flatlands of Contra Costa's north shore and into the Central Contra Costa valley plains. No other significant groundwater basin lies within Site 42. But a large one underlies most of the Livermore Valley southwest of the Site.

Estimated water quality conditions for the surface and groundwaters in and around Site 42 are presented in Table V-H-1. The surface water quality in the channels in the immediate vicinity of Sub-Area 42.3, Clifton Court, reflect seasonal variations responding to flooding and the pumping schedules of the pumps at the Delta and Tracy Pumping Stations located in this Sub-Area. These pumps pull relatively low TDS (under 150 mg/l) from the Sacramento River water across the Delta. The available information indicates that the surface waters in and around the Site Area vary from soft to very hard with the groundwaters generally being very hard. Most of the available specific information probably produces ion concentrations higher than that occuring in the surface and groundwaters well within the Site Area. The predominant ions in the surface waters derived from the Coast Range province western two-thirds of Site 42 are reportedly calcium, magnesium, and bicarbonate (Ref. 6,) while those in the Delta influenced southeastern part are reportedly sodium, potassium, sulfate, and chloride. The Delta influenced northeastern part (perhaps beyond the Study Site, however,) are reportedly characterized by calcium, magnesium, sulfate, and chloride ions.

Table V-H-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 42

Water Quality Characteristics	Surface Waters 1/	Ground Waters 3/	Current Standards 4/
Total Dissolved Solids:		about 722 mg/l	
Delta Area generally (low flows)	340-700 mg/l 2/		
Old River	178-184		-700 mg/l mean
Italian Slough	103-412		daily f/10 d
Indian Slough	168-188		450 mg/l mean
Big Break near mouth Marsh Cr.	91-260 3/		-annual
Site Area proper (low flows)	110-340 2/		none
Electro-Conductivity (micromhos):		about 45	
Old River	146-779		none
Italian Slough	165-751		none
Indian Slough	278-1560		none
Big Break near mouth Marsh Cr.	160-408 3/		none
Total Hardness:		about 218 mg/l	
Old River	39-168 mg/l		no numerical standards
Italian Slough	40-126		
Indian Slough	75-354		nms
Big Break near mouth Marsh Cr.	62-79 3/		nms
Total Non-Carbonate Hardness:		0	
Old River	9-58 mg/l		nms
Italian Slough	8-38		nms
Indian Slough	5-61		nms
Big Break near mouth Marsh Cr.	0-17 3/		nms
Total Nitrogen (TN):		-	
Big Break near mouth Marsh Cr.	0.38-1.48 mg/l 3/		2.0 mg/l
NO_3-Nitrogen:		about 1.6 mg/l	
Old River	0.13-0.68 mg/l		1.0 mg/l as TN
Italian Slough	0.20-1.17		1.0 mg/l as TN
Indian Slough	0.36-0.74		1.0 mg/l as TN
Big Break near mouth Marsh Cr.	under 0.05-0.9 3/		2.0 mg/l as TN

Table V-H-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 42

Water Quality Characteristics	Surface Waters 1/	Ground Waters 3/	Current Standards 4/
Total Phosphorus:		-	
Big Break near	0.07-0.17 mg/l 3/		nms
pH:		7.7-7.9	
Old River	7.6-8.3		6.5-8.5
Italian Slough	7.4-8.2		6.5-8.5
Indian Slough	7.2-8.6		6.5-8.5
Big Break near mouth Marsh Cr.	6.7-8.5 3/		6.5-8.5
Temperature:		-	
General Area median values	60-64°F 2/		nms
Big Break at mouth Marsh Cr.	50-75°F 3/		nms
Dissolved Oxygen:		-	
Big Break at mouth Marsh Cr.	8.8-10.5 mg/l 3/		5.0 mg/l min
Turbidity: (in JTU)		-	
Big Break at mouth Marsh Cr.	15-50 JTU 3/		150 JTU
Sediments:		-	
Eastern flatlands area	under 280 ppm 2/		none
Western valley areas	280-1950 ppm 2/		none
Ca:		about 45 mg/l	
Old River	18-24 mg/l		nms
Italian Slough	11-26		nms
Indian Slough	16-18		nms
Big Break near mouth Marsh Cr.	6-18 3/		nms
Mg:		about 36 mg/l	
Old River	6.8-7/1 mg/l		nms
Italian Slough	3.0-15		nms
Indian Slough	about 8.5		nms
Big Break near mouth Marsh Cr.	7.2-8.2 3/		nms

Table V-H-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 42

Water Quality Characteristics	Surface Waters 1/	Ground Waters 3/	Current Standards 4/
Na:		about 203 mg/l	
Old River	12-90 mg/l		nms
Italian Slough	15-89		nms
Indian Slough	26-176		nms
Big Break near mouth Marsh Cr.	14-27 3/		nms
Potassium:		about 4.1 mg/l	
Old River	1.2-3.0		nms
Italian Slough	1.2-3.0		nms
Indian Slough	about 1.6		nms
Big Break near mouth Marsh Cr.	1.7-2.0 3/		nms
CO_3:		0	
Old River	0-1 mg/l		nms
Italian Slough	0		nms
Indian Slough	0-28		nms
Big Break near mouth Marsh Cr.	0 3/		nms
HCO_3:		about 551 mg/l	
Old River	36-134 mg/l		nms
Italian Slough	39-112		nms
Indian Slough	71-348		nms
Big Break near mouth Marsh Cr.	76-77 3/		nms
SO_4:		about 3.8 mg/l	
Old River	28-31 mg/l		nms
Italian Slough	11-64		nms
Indian Slough	20-36		nms
Big Break near mouth Marsh Cr.	11-34 3/		nms
Cl:		about 159 mg/l	
Old River	19-126 mg/l		nms
Italian Slough	22-121		nms
Indian Slough	30-190		nms
Big Break near mouth Marsh Cr.	12-47 3/		1000 mg/l mean daily 200 mg/l 10 day max. 1Apr.-31 May

Table V-H-1 (Continued)

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY AREA 42

Water Quality Characteristics	Surface Waters 1/	Ground Waters 3/	Current Standards 4/
SiO_3:		-	
Old River	15-17 mg/l		nms
Italian Slough	15-18		nms
Indian Slough	13-14		nms
Big Break near mouth Marsh Cr.	9-22 3/		nms
B:		about 1.5 mg/l	
Old River	0-4.0 mg/l		0.5 mg/l
Italian Slough	0-1.3		0.5 mg/l
Indian Slough	0.1-2.7		0.5 mg/l
Big Break near mouth Marsh Cr.	0-0.55 3/		0.5 mg/l
Heavy Metals:			
Big Break near mouth Marsh Cr.			
Cd	under 0.01 mg/l 3/		0.01 mg/l
Cr	under 0.01-0.05 3/		0.05 mg/l
Cu	under 0.1 3/		0.01 mg/l
Fe	under 0.1-0.2 3/		0.3 mg/l
Pb	under 0.01-0.1 3/		0.05 mg/l
Mn	under 0.05 3/		0.05 mg/l
Zn	under 0.1 3/		0.1 mg/l

1. From Ref. 7
2. From Ref. 6
3. From Hydrology Data: 1969, Vo;. II: Northeastern California, Bulletin No. 130-69, California State Dept. of Water Resources, May 1971
4. From Ref. 183, surface waters only

b. Soils

The soils of Site 42 represent still another typical complex mix of the azonal soils of mountains and geologically young mountain valleys. No lithosolic (stony, or gravelly) soils are in evidence; but regosolic (alluvial) soils are. The soils of the Site can be very generally classified as semi-calcic chestnut and brown type warm dry soils; with nearly black, friable, organic-rich topsoils and subsoils showing substantial evidence of significant accumulations of calcium carbonate or gypsum and a small amount of evidence of significant clay accumulations. The mean annual soil temperature is over 47°F. There is little evidence of any significant development toward the stratification typical of the podzolic soils which are typical for the geologically older mountainous and/or coniferous forest regions (i.e., significant leaching of the surface layers under the humus top cover and a dense clayey subsurface stratum) in those sections of the Study Site where this might be expected. There is, however, significant evidence of development toward the chestnut and brown (steppe) and prairie types of chernozemic soils with the appearance of lime accumulations (calcareous) in certain soil profiles together with the development of distinct stratification between deep darker topsoils over lighter colored substratum and subsoils, the latter reflecting parent materials. The potential and/or historical natural vegetative cover for Site 42 is generally considered to be California steppe (Stipa) grasslands in the mid-elevations and California oaklands (Quercus) or Broad and Needle Leaf forests in the higher elevations (Ref. 2.) More detailed soil information concerning the specific identified soil associations found in the Study Site is presented in Tables V-A-2,3,9, and 10 (background reference Section A-3c, Refs. 10a,10b.)

The soils of the rolling and hilly and steep to very steep sloping uplands is composed of two major soil groupings; the generally neutral, brownish, calcerous, moderately deep to deep clays and clay loams of the Altamont-San Benito, Altamont-San Benito-Linne, and Diablo-Altamont soil associations; and the generally acid, predominantly brownish, shallow to moderately deep, generally north facing loams of the Los Osos-Millsholm-Gazos, Arnold, Los Gatos-Gaviota-Sobrante, and Los Gatos-Gaviota associations. Together they cover about 68 percent of Site 42. The first major soil grouping covers about 43 percent of Site 42 and predominates in Sub-Areas 42.1 and 42.4. It developed on soft shales and fine grained sandstone. It is found on slopes ranging from 9 to 50 percent, with about 55 percent of the area being on slopes over 30 percent. These soils are well drained and generally slowly permeable. Their erosion hazard ranges from small to high, generally increasing with increasing slope. They consist of neutral dark grayish brown clay and silty clay and dark gray heavy granular calcareous and thick clay topsoils; calcareous dark gray granular, gray, and

and grayish brown clay and brown silty clay subsoils; together with substratum of soft sometimes olive gray shales and fine grained sandstones and interbedded sandstones and shales. The second major soil grouping covers about 25 percent of Site 42 and predominates in Sub-Area 42.2. It is found primarily on sedimentary, basic and ultra-basic rocks and on slopes ranging from 9 to 70 percent; the higher slopes generally north facing, those over 30 percent accounting for about 84 percent of its coverage. These soils are well to very well drained and slowly to moderately permeable except for the Arnold association which is rapid. They consist of slightly acid gray clay loam, grayish brown heavy silty loam, brown sandy loam, reddish brown light clay loam, neutral brown and grayish brown loam, and strongly acid light grayish brown sandy topsoils; slightly acid grayish brown light clay, brown light clay loam, and reddish brown clay loam, neutral grayish brown loam, and strongly acid brown light sandy subsoils; together with substratum of interbedded sandstones and shales (20 to 36 inches down,) sandstones (at depths varying from 20-36, 10-20, and 0-10 inches,) and weathered basic igneous rocks (20 to 36 inches down.) The sandy soils in this grouping are associated only with the Arnold association.

The largest soil grouping in the more level areas of Site 42 is composed of the soils of the Brentwood-Zamora-Sorrento-Los Robles association. These loamy soils are very deep, well drained, moderately slow in permeability, and are found on level to nearly level alluvial fans and low terraces. They are developed from predominantly sedimentary rock. This soil association covers about 11 percent of Site 42 and is concentrated in Sub-Area 42.4. This soil is composed of modertately alkaline grayish brown clay loam, slightly acid grayish brown clay and silty clay loam, and neutral very dark grayish brown clay loam topsoils; moderately alkaline brown and dark brown heavy clay loam, mildly alkaline brown light silty clay loam, and slightly acid dark grayish brown heavy clay loam subsoils; together with substratum of yellowish brown calcerous silty clay loams, moderately alkaline brown clay loams, brown calcerous very fine sandy loams, and moderately alkaline brown heavy clay loams.

The second largest soil association in the more level areas of Site 42 is the Cropley-Rincon which covers about 8 percent of Site 42 and is concentrated in Sub-Areas 42.3 and 42.4. These fine to very fine textured clay soils are very deep, well drained, slow in permeability, and are found on nearly level basins, gently rolling fans, and small valleys. They exhibit no erosion hazard. This soil is composed of neutral dark grayish brown clay topsoils; neutral dark grayish brown and mildly alkaline brown clay subsoils; together with calcerous brown silty clay and calcerous yellowish brown silty clay loam substratum.

The third largest soil grouping in the more level areas of Site 42 is composed of the saline-alkali clayey soils of the poorly drained basin rims and old terraces. They cover slightly over 5 percent of Site 42 and are concentrated in Sub-Areas 42.4 and 42.3. This soil grouping is composed principally of the Solano-San Ysidro soil association together with the Pescadero association. These soils are composed of predominantly slightly acid brown and grayish brown massive loam topsoils with some moderately alkaline grayish brown clay topsoils; predominantly alkaline grayish brown columnar silty clay and neutral brown block clay subsoils with some calcerous mottled brown to grayish brown clay subsoils; together with a predominantly strongly alkaline pale brown clay loam and yellowish brown calcerous silty clay substratum along with some dry grayish blocky and grayish brown mottle clays.

c. Climatology and Meteorology

The climate of Contra Costa County is generally characterized by dry summers and wet winters with conditions in the eastern portion where Site 42 is located being more variable due to marine air masses coming through Carquinez Straights from the west. Temperatures are generally moderate over the entire county during winter and tend to quite warm in the inland areas during the summer. "Tule" fog is common in the Brentwood area in the northeast part of the Site during December and January. Mean annual precipitation, pan evaporation, potential evapotranspiration, and annual vegetative requirement for the various sub-areas are as follows:

	Site 42 Sub-Areas			
	42.1	42.2	42.3	42.4
Mean annual:				
Precipitation	11"	18"	13"	14"
Pan Evaporation	64.7"	64.7"	64.8"	64.7"
Potential Evapotranspiration	45.4"	45.4"	45.5"	45.4"
Vegetative Requirement	38.7"	36.7"	37.9"	38.4"

(see Table V-A-4)

About 80 percent of the annual percipitation occurs between November and March. About 70 percent of the pan evaporation takes place between May and September. Air temperatures average about 44°F in January and 68 and 72°F in July with the higher temperatures occuring in the eastern sections of the Site area. The average length of the growing season is about 280 to 290 days without a killing frost. Mean annual evapotranspiration from non-irrigated areas varies between 10 to 13 inches. Mean annual sunshine ranges between 3200 and 3400 hours per year. (Refs. 2,6,10a,10b,19.)

Summary of Air Quality Conditions: It is estimated that Site 42 currently experiences between 30 to 50 days per year when the oxidant levels are at or over the 0.10 ppm level. Background discussion for this has been presented in Section A-3d. The Study Site's proximity to Stockton to the east and Walnut Creek and Concord in central Contra Costa on the west together with the continuation of current development rates would indicate a general increase in these experiences with higher oxidant levels. The degree to which current air pollution control programs, Federal, state, and local, will effect this in the immediate future period is uncertain. (Ref. 142.)

3 - Environmental Setting Without the Project: Ecological

a. Vegetative Cover

Wastewater Application Site 42 (eastern Contra Costa County) supports four major vegetative cover types: agricultural, grasses and forbs, hardwoods (oak woodlands), and chaparral (Figure V-H-4). The agricultural areas along the northeastern boundary of the study area (south of Antioch, west of Brentwood) are highly diversified, supporting a variety of row (lettuce, tomatoes, sugar beets) and orchard crops (walnuts, cherries, apricots, peaches, pears, olives, figs). Native vegetation is not permitted to grow in the agricultural areas except along some canals and ditches or along the "weedy" edges of some fields. The vegetation in these areas is annual grasses and forbs. Cattails (Typha sp.) are found in some ditches.

The lowland foothills of the southeastern portion of the study area and the valley flatland of the area west of Clifton Court Forebay support annual grasses and forbs. These areas are used for grazing. Overgrazing in years past has caused the native perennial bunch grasses to be replaced by annual species of Avena, Festuca and Bromus. This replacement is typical of the Central Valley and surrounding foothill grasslands. Scattered valley oaks occur on some ridges in the rolling hill areas. Oaks are more numerous along watercourses (usually intermittent flow) in this area.

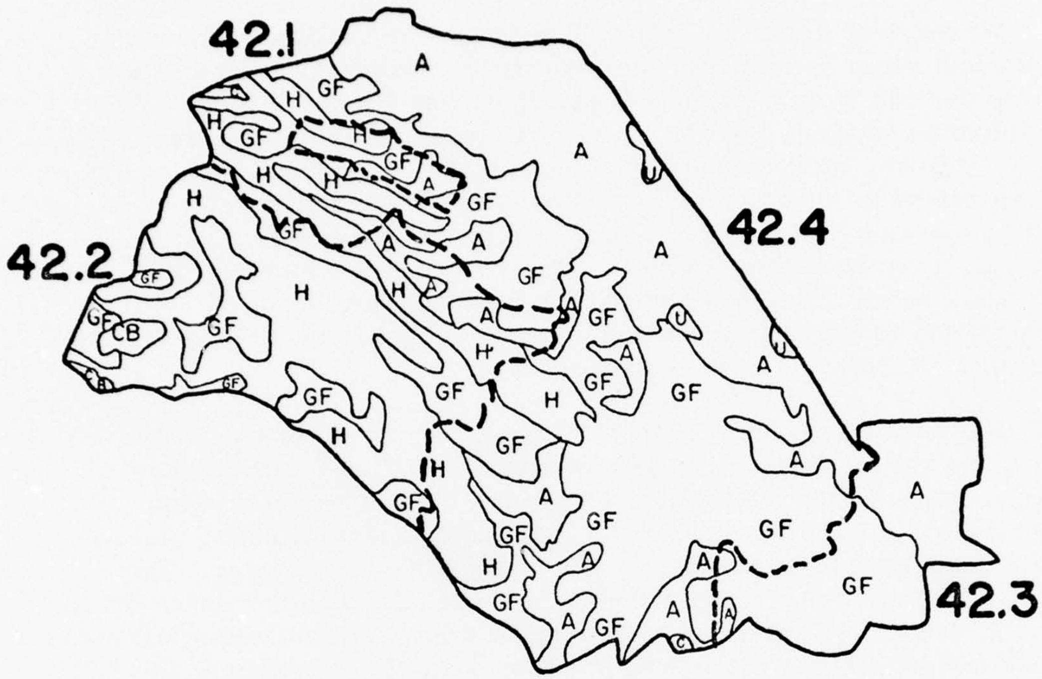
The vegetation along Italian Slough and Old River by Clifton Court Forebay is similar to the riparian vegetation listed for Site 43 (Table V-I-2). The levees of Clifton Court have not been invaded by native riparian vegetation.

The Black Hills west of Vasco Road and south of Marsh Creek Road support several different vegetative cover types. Oak-woodlands predominate with scattered areas of chaparral occurring on south (facing) slopes (Table V-H-2). Plant species of the oak woodlands are typical of the foothill woodlands plant community - a specific assemblage of plant species which is found on the foothills surrounding the Central Valley.

North facing slopes and ridge tops support dense oak woodlands while valley areas support more open oak woodlands with a grass and forb understory. Oaks are sparsely distributed in some of these areas. Chaparral growths are predominatly manzanita (Arctostaphylos spp.) and chamise (Adenostoma fasciculatum) while the woodlands are predominatly live and valley oaks (Quercus spp.). Black oaks (Quercus kelloggii) and California bay (Umbellularia californica) are found at higher elevations such as along

Figure V-H-4

EXISTING VEGETATIVE COVER IN SITE 42



COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

Table V-H-2

DOMINANT NATIVE VEGETATION OF WASTEWATER APPLICATION SITE 42

Vegetative Cover Type	Scientific Name	Common Name
Grasses and forbs	Bromus spp.	Chess
	Festuca spp.	Fescue
	Avena spp.	Oats
Hardwood (oak-woodland)	Pinus sabiniana	Digger pine
	Quercus lobata	Valley oak
	Q. douglassii	Blue oak
	Q. wislizenii	Interior live oak
	Q. agrifolia	Coast live oak
	Q. dumosa	Scrub oak
	Q. chrysolepis	Canyon oak
	Aesculus californica	California buckeye
	Rhamnus californica spp. tomentella	California coffeeberry
	Cercis occidentalis	Redbud
	Umbellularia californica	California bay
Chaparral	Adenostoma fasciculatum	Chamise
	Heteromeles arbutifolia	Toyon
	Rhamnus californica spp. tomentella	Coffeeberry
	Quercus dumosa	Scrub oak
	Ceanothus spp.	Ceanothus
	Arctostaphylos spp.	Manzanita
Riparian	Platanus racemosa	Sycamore
	Populus fremontii	Cottonwood
	Salix spp.	Willows

Morgan Territory Road in the southwestern portion of the study area.

Three parallel east-west valleys occupy the central portion of Study Site 42 - Briones, Deer, and Lone Tree Valleys. In each valley the south (facing) slope of the dividing ridges is grassland and the north slope is oak parklands (oaks and grasses with little or no brush). Deer and Lone Tree Valleys are grasslands used for grazing while Briones Valley contains orchards. The grasslands of Deer and Lone Tree Valleys are very dry and the existing vegetation of poor quality.

Lowland riparian areas support cottonwoods (Populus Fremontii) and willows (Salix spp.), while higher elevation riparian areas support sycamores (Platanus racemosa). Grassland riparian vegetation is represented by oaks, while oak woodland areas show a greater concentration of oaks and other species near water courses. Rare, endangered and possibly extinct plants whose distributions include Site 42 are listed in Table V-H-3.

b. Fish and Wildlife

Fisheries: The fishery in Site 42 is centered around the California Aqueduct, the Delta-Mendota Canal and Clifton Court Forebay - all in the southeast corner of Site 42. Contra Loma Reservoir south of the City of Antioch contains a warmwater fishery.

Black bass and sunfish (Centrarchidae), and catfish (Ictaluridae) are the most important gamefish of the area (see the Appendix - Chapter K, fish species list). They occur in all of the waters listed in Site 42.

The lower elevation streams are intermittent and at best support a fishery only during the wet season. Kellogg Creek at Vasco Road has a small amount of permanent water. During field observations of Site 42, fish were observed in Kellogg Creek. They were probably western suckers (Catostomidae).

Farm ponds were abundant in the foothills of Site 42. Most of them were dry or contained very little water. Most of the ponds were for livestock watering and did not appear to be managed for a fishery.

Wildlife: The densities of some important game animals are known, while the abundance of most non-game animals has not been determined by study or estimation by any agency.

Big Game. Black-tailed deer occur in densities of approximately 35 to 60 animals per square mile in the oak woodland on the east slope of

Table V-H-3

RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS OF WASTEWATER APPLICATION SITE 42

Species*	Local Habitat	Plant Community
Amsinckia grandiflora	Inner coast	Valley grassland
	Range and adjacent valleys	
Eriophyllum jepsonii	Dry rocky, often serpentine slopes	Foothill woodland
	1000-3500 feet	
	Inner coast range	
Helianthella castanea	Grassy hillsides	Valley grassland
	500-4000 feet	Foothill woodland
	Mt. Diablo State Park	
Parvisedum pentandrum	Rocky places, often on serpentine	Openings in foothill woodland
	800-2500 feet	Chaparral
	Inner coast range	
Streptanthus hispidus	Talus, rocky outcrops	Chaparral
	2000-3850 feet	
	Mt. Diablo State Park	
Tropidocarpum capparideum	Alkaline low hills below 500 feet, in region about the foot of Mt. Diablo	Valley grasslands

Table V-H-3 (continued)

RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS OF WASTEWATER APPLICATION SITE 42

Species*	Local Habitat	Plant Community
Arctostaphylos auriculata (a shrub)	Dry slopes of sandstone	Chaparral
	500-2000 feet	
	Mt. Diablo State Park	
Phacelia phacelioides	Uncommon, in rocky places	
	2000-3500 feet	
	Inner coast ranges	
	Mt. Diablo	
Calochortus pulchellus	Frequent on wooded and brush slopes	Foothill woodland
	Above 700 feet	Chaparral
	Mt. Diablo	
Fritillaria liliacea	Heavy soil, open hills and fields near coast	Northern coastal scrub
Hesperolinon breweri	Grassy or brushy slopes, partly shaded on serpentine	Chaparral Foothill woodland
	Inner coast range	
	400-3300 feet	
	Mt. Diablo	

Table V-H-3 (continued)

RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS
OF WASTEWATER APPLICATION SITE 42

Species*	Local Habitat	Plant Community
Hibiscus califoricus	Moist banks	Freshwater marsh
	Lower Sacramento and San Joaquin Rivers	
Eriogonum truncatum	Dry slopes	Edge of Chaparral
	1000-1500 feet	
	East base of Mt. Diablo	
Cordylanthus nidularius	Serpentine slopes	Chaparral
	2000 feet	
	Near Deer Flat	
	Mt. Diablo	
Sanicula saxatilis	3000-3800 feet	Chaparral
	Mt. Diablo	Foothill woodland

*Note: Common names are not known for all of these listed plant species. All species but one are forbs.

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Mt. Diablo and along Morgan Territory Road. In the agricultural areas and in the sparse oak-woodland areas, the population density is about 15 to 20 animals per square mile. The number of animals also depends upon the amount of riparian cover available, more cover allows for a larger population. Crop depredation is a problem in the agricultural lands on the eastern side of Contra Costa County. In general, the deer population has probably reached or surpassed the carrying capacity of the land.

Mountain lion are found in the mountainous eastern Mt. Diablo area. Their status is not presently known.

Upland Game. Brush rabbits are commonly found in brushy, riparian habitat. California Department of Fish and Game personnel feel that the relative abundance of brush rabbits along Morgan Territory Road has declined. But, they feel this is only a normal, cyclic fluctuation in abundance. Actual numbers or densities of this animal are not presently available (Ref. 46).

Ring-necked pheasants occur only on the agricultural areas around the cities of Brentwood and Byron. Irrigated pasture, corn, grainfield, and weedy edges are necessary components of their habitat. Their present populations are considered to range from below average to moderate. A population of one bird per two acres is considered to be very high.

California valley quail populations are high (190-380 per square mile) in both the agricultural lands in eastern Contra Costa County and in the brushy foothill areas and riparian areas east of Mt. Diablo. A California Department of Fish and Game survey indicates that quail populations have been high for the past two years (about 380 per square mile). The carrying capacity of foothills areas east of Mt. Diablo has probably been reached. Data obtained by the California Department of Fish and Game near San Pablo Reservoir, Contra Costa County, serves as an index of relative abundance. The results indicate a high population density.

Male California valley quail call count, conducted by driving a car down a 10-mile stretch of road and noting each male call. Data received from a brushy area near San Pablo Reservoir, Contra Costa County (from Ref. 46).

June, 1971	10 mile run	25	male birds heard
		2	male or female birds seen
June, 1972	10 mile run	24	male birds heard
		-0-	male or female birds seen

Mourning dove populations have been higher than usual for several years in the foothill areas in central Contra Costa County and the agricultural areas of eastern Contra Costa County. Population densities will fluctuate radically from year to year depending upon the weather. A wet, cold winter will reduce the reproductive potential and decrease survivability of squabs. California Department of Fish and Game data taken at Briones, Contra Costa County, is listed below. The figures indicate the number of male birds heard calling and the number of both sexes seen.

Number of male mourning doves calling, and the number of both sexes seen. Data collected near Briones, Contra Costa County (from Ref. 46).

Month	Year	Number Heard Male Only	Number Seen Male and Female
May	1968	32	12
May	1969	32	14
May	1970	33	19
May	1971	36	17
May	1972	34	15

Band-tailed pigeon have not been seen in Area 42 for the past several years according to Bruce Elliot, California Department of Fish and Game. This could be due to poor feeding conditions (particularly oak mast) or to insufficient observation time.

Waterfowl. Very little of Site 42 is suitable for waterfowl. Clifton Court Forebay does offer stopping and resting area for migrating waterfowl, but offers little in food or cover for dabbling ducks.

Contra Loma and Marsh Creek Reservoirs are small bodies of water, but their shorelines contain tules, cattails, and some bulrushes for cover.

See Table V-H-4 for a list of birds and mammals observed in Site 42 and the Appendix (Chapter K) for a complete list of all species found in Site 42.

Table V-H-4

ANIMALS OBSERVED DURING FIELD OBSERVATIONS SEPTEMBER 29, 1972 OF WASTEWATER APPLICATION SITE 42

Birds	Mammals
Pied-billed grebe	Opossum
Great blue heron	Meadow mouse
Ruddy duck	Muskrat
Red-tailed hawk	
American kestrel	**Reptiles**
White-tailed kite	
Turkey vulture	Western pond turtle
California valley quail	Western fence lizard
Ring-necked pheasant	
Killdeer	**Fish**
Coot	
Common gallinule	Western sucker (Catostomidae)
Mourning dove	
California acorn woodpecker	
Red-shafted flicker	
Western kingbird	
Scrub jay	
Yellow-billed magpie	
Common crow	
Mockingbird	
Hermit thrush	
Loggerhead shrike	
Meadowlark	
Red-winged blackbird	
House finch	
Song sparrow	

Rare and Endangered Species: Eighteen species of rare or endangered animals are thought or known to occur in Site 42. They are listed in Table V-H-5.

Table V-H-5

RARE AND ENDANGERED ANIMAL SPECIES OF SITE 42

Common Name	Status	Occurrence
Reptiles		
Alameda Striped racer	R	x
Giant garter snake	R, U	x
Birds		
Tule white-fronted goose	E	*
Aleutian Canada goose	E	*
Red-bellied red shouldered hawk	U	*
Ferruginous hawk	U	x
Southern bald eagle	E	*
American osprey	U	x
Prairie falcon	R	x
Greater sandhill crane	R	*
American peregrine falcon	E	*
Mountain plover	U	x
Alaskan short-billed dowitcher	U	*
California yellow-bellied cuckoo	R	*
Yukatat fox sparrow	U	*
Mammals		
San Joaquin kit fox	E, R	*
Salt marsh harvest mouse	E, U	*

E Endangered

R Rare

U Status uncertain

x This species or subspecies definitely or probably occurs on the wastewater management area.

* Occurrence of this species or subspecies on the wastewater area is uncertain or questionable.

Refer to the Appendix (Chapter K) for a complete list of all rare or endangered species occurring in all wastewater management areas.

The Alameda striped racer occurs in the east San Francisco Bay Area inhabiting chapparal, grassland, open woods and rocky slopes. Its habitat has been greatly reduced by construction and development.

The raptorial birds (birds of prey) - the hawks, falcons, and eagles - face the common problem of excessive pesticide accumulation in their tissue. Being the final link in food chains, they accumulate the largest amounts of pesticides. The pesticide accumulations appear to result in the production of thin shelled eggs which are easily cracked and destroyed before hatching. Additional decimating factors include unlawful shooting, encroachment of people and development near nesting and feeding sites. American peregrine falcons have also been taken illegally by falconers.

The salt marsh harvest mouse, tule white-fronted goose, Aleutian Canada goose, greater sandhill crane, Alaskan short-billed dowitcher, yellow-billed cuckoo, and the giant garter snake are primarily water or marsh associated animals. The reduction of existing marsh land by diking, dredging, and filling operations has reduced the available habitat of all these species. Channelization and the removal of riparian vegetation is another critical factor in the life history of these animals.

The oak-woodland on the east slope of Mt. Diablo and along Morgan Territory provides cover and food for mammals and birds of the area. Oak mast (acorns) provide autumn food for blacktail deer, gray squirrels, the California acorn woodpecker, and other animals. The higher elevation areas also provide cover for mountain lion, which feed upon local deer populations.

The grasslands in southern Contra Costa and northern Alameda County provide foraging areas for some raptorial birds. Red-tailed hawks and white-tailed kites search the grasslands for small rodents and mice during the day. Mammals, such as coyotes, feed nocturnally on small rodents and hares. Black-tail deer move into the grasslands to feed on young grasses and forbs in the spring.

The San Joaquin kit fox occurs in the arid flatland and canyons of the southern San Joaquin valley. Suitable habitat for this species appear to exist as far north as the foothill areas of Contra Costa County, an area of habitat similar to that occurring in the lower San Joaquin Valley. The primary causes of the reduction of kit fox populations include conversion of their habitat into agricultural crops and illegal and indiscriminant shooting.

Fish Diseases and Parasites: The afflictions of fish species found in Site 42 will be essentially the same as in Site 4. (See B-24-29)

Wildlife Disease: Under present conditions, there are no wildlife disease problems in southeastern Contra Costa County with the exception of Clifton Court Forebay where a minor outbreak of avian cholera recently appeared in waterfowl. The wastewater discharge destined for Site 42 would have no influence on this problem considering the present and future management of the forebay.

The reservoir on Marsh Creek has not contributed any wildlife disease problems. The proposed reservoir on Kellogg Creek could have an adverse effect on waterfowl if changing water levels contributed to conditions favoring the occurrence of botulism. Vegetation control in shallow areas would prevent the appearance of botulism, and water quality should insure a minimum of nutrients which might encourage algae and micro-organisms growth.

The development of Sub-Area 42.2 could create a threat to the health of deer where forested regions are adjacent to permanent pastures, and the situation could be more acute in Sub-Area 42.4 where chaparral and irrigated pastures are contiguous. This type of ecotone is usually the locality of overwhelming parasitic worm infections of deer. There are several categories of these internal parasites including "stomach" worms, lungworms, both of which can be fatal, as well as tapeworms and liver flukes (Ref. 111). These parasites will be discussed in greater detail where they are known to occur, specifically in Site 18. The extent of adverse impact in Sub-Areas 42.2 and 42.4 cannot be forecast since the species of worms are not prevalent at present, but some of these parasites must exist in the deer now at the low rate of infection. The irrigated pastures which the deer would seek could cause the rate to increase to the point of causing substantial loss.

c. Ecological Systems

In the agricultural areas around the cities of Brentwood and Byron, "weedy" edges of fields are important habitat for birds and mammals. They provide cover for pheasants, quail, and songbirds, such as meadowlarks and song sparrows. In addition, brush piles provide protective and nesting cover for wildlife.

The presence of brush piles as well as "weedy" field edges depend on the concern of the local landowner or manager for wildlife maintenance and propagation.

Riparian and marsh habitats were very minimal in Site 42. Marsh and Kellogg Creeks have some areas of riparian habitat along their water-

ways. Sycamores and willows provide nesting cover for birds and in their lower branches cover for raccoons, weasels, and skunks. Marsh areas are available to wildlife at Contra Loma Reservoir and Marsh Creek Reservoir. This habitat is important to provide cover and food for migrant and resident waterfowl and marsh associated mammals, such as raccoons, minks and weasels.

d. Recreational Resources

Site 42 has an estimated recreational use potential of 266 million visitor days per year available, but actual use is minimal. Warm-water fishing, deer, dove, quail and rabbit hunting, day hiking, horseback riding, camping, picnicking, boating and swimming are all available recreational activities.

Present Public Facilities: Two major public recreational facilities partially in or immediately adjacent to the Study Site are Mt. Diablo State Park and Contra Loma Reservoir. Mt. Diablo State Park occupies a major portion of the western part of Sub-Area 42.2; its total area is 7,000 acres, only part of which projects into the Study Area. It contains 255 picnic units, 350 parking units, 80 camping units, and 11 miles of trails. Recent usage has been estimated at 281,400 visitor days per year; projected usage for the year 2000 is estimated at 561,500 visitor days per year (Ref. Vol. II report, Table II-G-1). Contra Loma Reservoir is located just beyond the northern perimeter of Sub-Area 42.4 northwest of the Antioch Airport. It occupies a total of 800 acres.

Other public facilities within or adjacent to the Study Area include Brentwood neighborhood park (at Brentwood) and Antioch Municipal Golf Course. The neighborhood park is a small local facility while the golf course is a regional recreation site. A state game refuge also exists adjacent to Mt. Diablo State Park. There are no recreation site improvements on the refuge and no wildlife management is practiced. It is a refuge by legislative decree and is patrolled by California Fish and Game employees. Its recreation value is primarily as open space and wildlife habitat.

Present Private Facilities: Private recreation development within Site 42 is extremely limited. One important private facility in Sub-Area 42.2 is the Royal Oaks Country Club. It occupies about 100 acres off Marsh Creek Road and contains 300 picnicking units and 500 parking units. Recent usage is estimated at 100 visitor days per year while its estimated projected usage for the year 2000 will be about 200 visitor days per year.

There are also two small private parks in the western wooded foothill region (sub-area 42.2). Curry Creek Park on Morgan Territory Road contains swimming and picnicking accommodations while Marsh Creek Springs Park on Marsh Creek Road is presently expanding its picnicking facilities to include swimming. Within the boundaries of Mt. Diablo State Park itself, the Boy Scouts of America, Mt. Diablo Council, operate a 97-acre wilderness park and camp ground for its members. No records are available describing user days for these private facilities.

Many of the homes along western Marsh Creek Road and Morgan Territory Road have accompanying horse boarding facilities. Horseback riding is obviously a popular pastime with many of the residents in this area. Actual locations of riding were not determined.

Several private boating facilities exist along the extreme southeastern corner of the area. A list of these sites and their accommodations follows.

Private Boating Facilities - Site 42

Old River	Launching	Berths	Mooring	Dry-Storage	Accommodations	Camping	Picnic	Trailer
Pels Boat Harbor	x					x		
Livermore Yacht Club	x	x						
Italian Slough	x		x					

Hunter and Angler Use: A limited amount of hunter use data applicable to the area has been made available through a California Fish and Game post-season postcard survey. The following information (Table V-H-6) has been compiled by county, thus it is not specific to the Study Area.

Table V-H-6

1970 HUNTER SURVEY - CONTRA COSTA COUNTY*

	Bag	Hunters
Pheasant	9,500	4,600
Quail	17,000	1,400
Doves	79,300	7,000
Pigeon	1,800	200
Jack rabbit	16,100	2,200
Cottontail	- 0 -	- 0 -
Tree squirrel	700	100
Ducks	64,600	5,800
Geese	2,800	1,900
Jacksnipe	1,000	100
Coots	2,900	700
Deer	1,000	2,200

* From unpublished records of California Department of Fish and Game, Sacramento.

In a separate report based on deer kill check station data, the California Department of Fish and Game estimated an average annual kill of only 252 deer per season over the last three years in the Mt. Diablo subdivision of the South Bay wildlife management unit (Ref. 34). The discrepancy between these figures and those derived from the postcard survey may reflect the inadequacy of a two percent post-season hunter survey. No angler use information is available.

Open Space: All of the lands included within Site 42, excepting Byron and Brentwood, are classified as open space on the Contra Costa County land use and circulation plan of 1963. The open space category is subdivided into intensive and extensive agriculture and recreation areas (extensive agriculture includes dry range grazing of cattle and horses and dry-farming grain crops). Intensive agriculture exists primarily on the eastern flatland while the upland and hill regions are designated extensive agriculture. Recreation areas delineated on the 1963 plan as open space include the Mt. Diablo State Park vicinity, Contra Loma Reservoir, Marsh Creek Reservoir, the proposed Coalmines and Kellogg Creek Parks, and the roadway corridors of Marsh Creek Road and Morgan Territory Road. The open space element of the Contra Costa

County General Plan is presently being revised in accordance with a state law that requires an open space plan for every county by June 1973.

Future Public Facilities: The East Bay Regional Park District has proposed two new recreational facilities within Site 42. These are Coalmines Park (a historical site) and Marsh Creek Reservoir park. Coalmines Park is proposed to have camping, picnicking, hiking, and horseback riding areas; 2,500 acres are to be purchased for this park. No information is available concerning planned development or facilities for the proposed Marsh Creek Reservoir park. Marsh Creek Reservoir is presently a flood control reservoir and it is not open to the public.

Recreational facilities are also proposed for Bethany Reservoir in Alameda County. This reservoir is part of the California Water Plan and all recreational development will be supervised by the State Department of Parks and Recreation. At present limited parking, picnicking and sanitation facilities are being installed on the reservoir site, as it is the northern end of the California Aqueduct bike trail set for completion in October 1972. Additional facilities are proposed for Bethany, including camping, boating and picnicking areas. The parks and recreation element of the Contra Costa County General Plan also proposes a community park at Brentwood and a neighborhood park in Byron. Completion dates and lists of facilities are not available at present for these small recreation sites. The planning department also intends to establish a series of bike, horseback and hiking trails throughout the country. The trail routes have not yet been published.

e. Protected Waterways Designations

The California Aqueduct and the Delta-Mendota Canal are designated as Class III warmwater fisheries in the California Protected Waterways Plan. No other resources are classified under the California Protected Waterways Plan in Site 42. The San Joaquin Delta which borders the area has been recognized as a scenic, recreation, fishery and wildlife waterway.

4 - Environmental Setting Without the Project: Cultural

a. Archaeological and Historic Site Locations

It has been estimated that the potential archaeological sites are few and scattered and would be located near the drainage channels of the Study Site (Ref. 11). No archaeological surveys of the area have reportedly been conducted.

The only historic landmark of note in Site 42 is considered to be the stone house of Dr. John Marsh, now owned by Contra Costa County. It is located immediately below the Marsh Creek Reservoir. A distant and a close view of the house is shown in Figures V-G-3a and 3c. Dr. Marsh was a pioneer physician in the state and purchased the Spanish land grant, Rancho Medanos, in 1837. The stone house was built in 1856.

b. Scenic Locations

Several areas within Site 42 have been recognized for their scenic value. The entire Sacramento-San Joaquin Delta and Marsh is classified as a premium (Class I) scenic and recreational waterway under the California Protected Waterways Plan (see Section A-3e). This includes the northern half of Sub-Area 42.3 since it borders the Delta along a small portion of the Old River and because most of these Delta flatlands are within the legally defined limits of the Delta. The Old River itself is specifically listed as a scenic waterway under this Plan (Ref. 30.)

SR 4 (from Brentwood to just north of Byron) and the Byron Highway (County Road J-4) from Byron on through Sub-Area 42.3 have been proposed for inclusion in the California State Scenic Highway System (see Section A-3f). Once included, corridors along these routes will be maintained to preserve their present scenic values.

Apart from official or proposed official scenic designations, Site 42 has a number of other areas possessing scenic values worthy of mention and preservation. The heavily vegetated lands along Morgan Territory Road (and upper Marsh Creek, Sub-Area 42.2) are unique to the Site and offer pleasant surroundings for touring by car, horseback or on foot. Also the low ridges and valleys west of Deer Valley (northwestern part of Sub-Area 42.4) provide a pastoral setting of special beauty in the spring, when annual grasses cover the slopes.

These scenic values are somewhat marred by the ever present appearance of roadside refuse scattered all along the edges of the Study Site's many major and minor roads and concentrated particularly at natural

and specifically provided pull-off viewing areas and stopping sites. The universal "indicator" of this is the beer can.

Some idea of the scenic values of Site 42 can be anticipated in some of the views presented in Figures V-H-5a, 5b, and 5c.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX -
THE PUBLIC HEALTH IMPLICATIONS OF LAND
APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

a. Impact 1

The first impact of wastewater land application would be the loss of vegetation, wildlife habitat, and wildlife on spoils areas due to whatever excavated materials resulted during construction of the facilities.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 13 for Site 4 (Section B-6m)

b. Impact 2

The second impact would be the loss of wildlife through loss of habitat (lands, vegetation) to general project facilities.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 5 for Site 4 (Section B-6e).

c. Impact 3

The third impact would be the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 4 (Section B-6L).

d. Impact 4

The fourth impact would be the reduction in the water quality of recovered water from surface, subsurface (underdrains) and ground waters (surface streams).

Discussion: The estimated recovery water contains several components which could degrade the water quality of Site 42: total nitrogen (TN), total phosphorous (TP), and total dissolved solids (TDS). These estimates are presented in Table V-A-7.

Existing water quality conditions with respect to TDS, TN, and TP are presented for various points in or adjacent to Site 42 in Table V-H-1.

Estimated TDS of groundwater and subsurface drainage after application of treated wastewater to forest, pasture or cropland exceeds present median

groundwater TDS for the area. The estimated TDS of recovered surface drainage exceeds existing conditions in several locations (Old River, Big Break, and Site 42 proper) and is very close to the upper range of TDS presently found in Italian Slough (see Tables V-A-7 and V-H-1, TDS). Surface and subsurface drainage of wastewaters into Big Break may degrade present water quality conditions found there. Wastewater drainage into Italian Slough could degrade water quality since the upper limit of TDS presently found there is approximately the lower limit of TDS expected in the recovered wastewater. High TDS (over 1,000 mg/l) is suspected of reducing reproductive capacities in some fish species among the Centrarchids and Cyprinids (sunfish and carp). However, the Sacramento perch may do better under high TDS conditions.

Total nitrogen levels higher than 1 mg/l and phosphorous levels above .1 mg/l generally encourage noticeable growths of algae. Waters which are righ in nitrogen and phosphorous can have algal "blooms" of such magnitude that fish and other aquatic animals may be killed by associated sags in available oxygen (oxygen used by the living and decomposing algae).

The threat of algal blooms should be taken into consideration before applying wastewater to lands that have subsurface drainage into Contra Loma Reservoir, Clifton Court Forebay, Bethany Reservoir, and Marsh Creek Reservoir. These water bodies presently support fishable populations of warmwater species. Drainage into Marsh Creek and Kellogg Creek should also be monitored if reestablishment of warmwater and steelhead fisheries is desired by making these streamflows perennial. The TN for Big Break is .38-1.48 mg/l The probability for eutrophication is high and values above 1.0 mg/l already exist.

The waters collected in drainage ditches and canals (surface and subsurface) may have TDS values in excess of those values which affect fish reproduction. TP and TN values are judged to exceed those values that encourage algal growth. They generally exceed those limits recommended by the State as suitable for dischange to the Delta.

Remedial, Protective and Mitigation Measures: Recovery waters should not be expected to have a sustaining fishery in areas of high TDS. Outfall locations should be limited to those areas with adequate mixing and dilution flows (as opposed to restricted channels and dead-end sloughs). Monitoring of all outflows will be necessary to control the water quality of the effluent. High TDS, total nitrogen and total phosphorous waters may require pre- and post-application treatment to prevent degradation of surface or groundwaters.

e. Impact 5

The fifth impact would be TDS buildup in soils that receive treated wastewater.

Discussion, and Remedial, Protective and Mitigative Measures: Refer to the discussion of Impact 6 for Site 28 (Section G-6f).

f. Impact 6

The sixth impact would be the loss of recreation opportunities and potential due to a reduction in the water quality and the quality and quantity of vegetation, fish and wildlife in reservoirs, farm ponds and streams.

Discussion: Present and potential uses of Contra Loma Reservoir, Bethany Reservoir, Marsh Creek Reservoir, Clifton Court Forebay, Marsh Creek and Kellogg Creek for fishing and hunting of game species might be either diminished or enhanced by a change in water quality. The effect on these values will depend on the area management scheme that is implemented. Present hunting and fishing opportunities within Site 42 are already minimal. Farm ponds, although plentiful in the area, are nearly or completely dry for extended periods during the summer. The large number of potential recreationists in the nearby San Francisco Bay area communities warrant enhancement of recreational opportunities in Site 42.

Remedial, Protective and Mitigation Measures: Monitor watercourses that are receiving recovered wastewater to control and keep the water quality within public health water contact specifications and requirements needed to maintain a warmwater fishery. (Water quality standards in policy of California Water Quality Control Board; otherwise must be set on a case by case by case basis.

Control wastewater quality pre- and post-application to insure acceptable water quality of waters discharged into recreation waterways.

Eutrophication of streams can be partially mitigated and bankside wildlife habitat may be enhanced by channelization if carried out in a manner designed to enhance wild land and stream values. See Soil Conservation Service, October 1971, Planning and Design of Open Channels, Technical Release #25, Chapter 7, Environmental Considerations.

g. Impact 7

The seventh impact would be an increase in gamebird habitat.

Discussion: An increase in water available for farming may expand intensive agriculture into areas presently only grazed or completely unused. Row and field crops can supply habitat necessary to pheasant, quail and dove if properly managed by maintaining edge cover and water source, having no field maintenance during nesting (April-May), and planting grain crops. The bottom of Briones, Horse, Deer and Lone Tree Valleys and flat lands west and south of Clifton Court Forebay are examples of lands that may provide additional cover if put into field or row crops. Management and maintenance of edge cover along fences, watercourses,

and planned corridors or plots would be necessary to expand gamebird range into new areas.

This action would be a beneficial impact. The management of agricultural lands to provide cover for gamebirds is, however, at the discretion of the land owner. Also, the "weedy edge" cover can be very easily removed. Soil Construction Service and other agencies actively promote wildlife habitat and try to educate land owners to wildlife values.

h. Impact 8

The eighth impact would be an increase in waterfowl resting and hunting sites because of the short supply of marshland in California.

Discussion: Impoundment of wastewater for storage or infiltration would create areas for resting waterfowl. These same areas might be made available to controlled public access for the purpose of hunting waterfowl, if water quality meets public health standards. Clifton Court Forebay is an example of such a controlled waterfowl hunting and resting site.

This would be a beneficial impact.

i Impact 9

The ninth impact would be the destruction of wildlife habitat and edge cover along existing canal systems.

Discussions: Use of present canal systems in agricultural areas to distribute additional wastewater might require removal of heavy vegetation in and along those canals for optimum waterflow efficiency. The orchard and field crop lands in the northeastern section of the area offer little wildlife habitat other than the canal and streambank cover. Its removal would significantly reduce available wildlife habitat.

Remedial, Protective and Mitigation Measures: Management and maintenance of sufficient edge cover in surrounding fields to replace cover lost through clearing of canal banks.

j. Impact 10

The tenth impact would be the reduction of the quality in groundwater stores used for domestic purposes.

Discussion: Groundwater and subsurface water quality on sites receiving wastewater may be reduced from present conditions (note Discustion, Impact 4). Residents throughout the area depend upon groundwater supplies for domestic use. Reduction in groundwater quality may adversely affect the general health of local residents and domestic and wild animals which use these water sources.

Remedial, Protective and Mitigation Measures: Quality of groundwater in disposal areas should be monitored to maintain a level compatible with general health standards.

Application of wastewater should be confined to those areas largely uninhabited or to areas with domestic water sources other than groundwater.

Residents should be supplied with an alternate source of domestic water.

k. Impact 11

The eleventh impact would be the loss of present and potential recreation and riparian vegetation along major stream channels.

Discussion: Increased stream runoff created by dumping wastewater directly into channels or by increasing overland and subsurface drainage into streams may cause severe bank cutting, slumping, and removal or vegetation. A potential for streamside recreation would be adversely affected depending on the amount and schedule of water released. As an example, increased runoff in upper Marsh Creek may cause bank cutting and slumping at Royal Oak Golf Course, Camp Curry and Marsh Creek Springs Park; private recreational developments on terrace land along Marsh Creek. Bank cutting and slumping lead to stream turbidity and loss of fish habitat downstream.

Remedial, Protective and Mitigation Measures: Land application of wastewater should not be made directly to stream channels or in great quantities onto lands immediately surrounding streams unless a program is implemented to prepare streams for increased flows that also enhance the natural values. (Channelization: see SCS, October 1971, Planning and Design of Open Channels, Technical Release #25, Chapter 7, Environmental Consideration.) Otherwise, application of wastewater made directly to stream channels or surrounding slopes should be of small enough volume (should be tested) so as not to promote bank cutting, channel erosion and/or loss of riparian vegetation.

l. Impact 12

The twelfth impact would be the enchancement of fishery potential in Marsh and Kellogg Creeks.

Discussion: Wastewater application of sufficient quality and quantity to promote perennial flow in Marsh and Kellogg Creek drainages would allow reintroduction of warmwater and possibly steelhead fisheries to these streams. Kellogg Creek historically contained a significant run of steelhead and presently contains a small warmwater fishery. Lack of perennial flow is the main limiting factor to fisheries in Marsh and Kellogg Creeks. Increased flow would probably permit the development of a warmwater fishery consisting of Centrarchids, Ictalurids and Cyprinids; any recreational fishery would probably be for sunfish and bullheads.

This is a beneficial impact, provided that increased flows do not cause accelerated erosion of the streambed and stream turbidity.

m. Impact 13

The thirteenth impact would be the reduction of water quality in Sacramento-San Joaquin Delta.

Discussion: High nitrogen and phosphorous levels in recovery water from wastewater disposal sites may affect critical water quality in Delta. Waters draining through Marsh Creek and its tributaries enter Delta Waters through Big Break. This water immediately circulates through Dutch Slough and flows southward toward Clifton Court Forebay. Waters draining through Kellogg Creek enter the Delta at Indian Slough and also flow south into Clifton Court Forebay. Clifton Court waters support present recreation (fishing) and are also pumped through the Delta Mendota Canal and California Aqueduct to southern portions of the state. Recreational, commercial and domestic use of the pumped water must be considered in any degradation of Delta water quality.

It is estimated that construction of the Peripheral Canal will reverse flow directions through Indian Slough, Dutch Slough and Big Break, with those waters emptying into the San Joaquin River and San Francisco Bay rather than flowing south to Clifton Court Forebay.

Remedial, Protective and Mitigation Measures: Monitoring and control of recovery water quality should be maintained at acceptable public health or recreational use standards.

Recovery water should be treated and recycled for commercial uses outside the area. (Public Health, Vol. IV, Part III, Public Health.)

Recovery waters should be discharged only into Delta waterways which have sufficient flow to dilute the wastewaters.

n. Impact 14

The fourteenth impact would be a change in the micro-climate by the increased available moisture.

Discussion: A change in the plant and animal species will result with the maintenance of high humidities, especially over pasture and marsh areas. Sprinkler or mist application of wastewater to lands presently grazed (Deer, Briones, Lone Tree and Horse Valleys for example) may create permanent pasture with a new plant community in place of present annual grasses and forbs. Heavy application in lowland areas (between Brentwood and Byron, for example) may turn present agricultural lands into marshland. Refer to the discussion of Impact 4 for Site 5 (Section C-6d) for further pertinent commentary on this topic. (Permanent pasture species will depend on rancher; see Vegetation H-23 to 26.)

Remedial, Protective and Mitigation Measures: The impact can be mitigated by the reduction in volume or frequency of application of incoming water. (Refer to Impact 4 for Site 5, Section C-6d).

o. Impact 15

The fifteenth impact would be the introduction and encouragement of wildlife and fish diseases from wastewater applications.

Discussion: Development of permanent pasture adjacent to forested and chaparral areas through wastewater application might bring harmful parasitic worm populations (lungworms, tapeworms, liver flukes, "stomach" worms) into close contact with deer herds. Bottom lands along Vasco Road and in Briones and Deer Valleys are in close proximity to popular deer range. They are also areas of possible conversion to permanent pasture and should receive special consideration. Irrigated pastures are characteristically sites of parasitic worm infestations which may prove harmful to deer, especially if there are domestic sheep present harboring these parasites. Even if there were an overall increase in deer population it would not offset the increase in deer diseases.

Remedial, Protective and Mitigation Measures: Manage all wastewater application to diminish or prevent disease occurrence.

Monitor wastewater pre- or post-application to prevent the introduction of disease organisms.

Limit introduction of irrigated pasture to areas away from deer concentrations, such as the east slope of Mt. Diablo. More specific information would require on-site survey of deer herd.

p. Impact 16

The sixteenth impact would be a change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 5 (Section C-6L).

q. Impact 17

The seventeenth impact would be the improvement of Sacramento-San Joaquin Delta salt water intrusion problem.

Discussion: Wastewater application runoff would increase the volume of freshwater flow into the Delta if recovery water TDS values were maintained well below present Delta water TDS values. Delta TDS fluctuates widely with volume of freshwater inflow from the Sacramento and San Joaquin Rivers and tidal action. Beneficial effect of recovery water input would depend not only on recovery TDS, but also volume of outflow, tidal stage and total Sacramento-San Joaquin River flow at the time of discharge.

This is a beneficial impact (needs to be run through hydrologic model), if at least some of the recovered wastewater flows north into Big Break near Oakley. Wastewater flowing into Clifton Court Forebay would not improve the Delta salt intrusion problem.

r. Impact 18

The eighteenth impact would be a reduction in scenic value of roadside areas.

Discussion: Construction of permanent above-ground delivery and dispersal system along well-traveled scenic routes will be a detriment to the recreational value of the area. Roadways along upper Marsh Creek and within Mt. Diablo State Park are especially scenic and should be protected from degradation. Location of dispersal systems should be kept away from contact by the general public for health as well as scenic reasons.

Remedial, Protective and Mitigation Measures: Delivery and dispersal systems for wastewater should be located away from roadways and popular recreation sites.

Planting of roadside trees and shrubs would mitigate the undesirable scenic effects of delivery and dispersal systems clearly visible from roads.

s. Impact 19

The nineteenth impact would be the generation of unpleasant odors.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 21 for Site 5 (Section C-6u).

t. Impact 20

The twentieth impact would be increased mosquito and midge populations.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 5 (Section C-6p).

u. Impact 21

The twenty-first impact would be the possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater. Which parasites and disease loads are problematical.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 15 for Site 4 (Section B-6o).

v. Impact 22

The twenty-second impact would be the introduction of fish diseases and parasites into new areas by the application of treated wastewater, though not highly probable but still possible.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 4 (Section B-6p).

w. Impact 23

The twenty-third impact would be an increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 17 for Site 4 (Section B-6q).

x. Impact 24

The twenty-fourth impact would be an increase in stress factors of fish and their relationship to the susceptibility of fish to disease and parasitism.

Discussion: The drainage of wastewater into surface waters could cause a change in the surface water quality. A change in water quality that included low dissolved oxygen (because of increased biochemical oxygen demand), and this will depend on the amount of organic matter in the water, or increased water temperature above optimum levels may produce conditions in fish that would increase their susceptibility to disease and parasitism.

Crowding fish into isolated pockets may also create stress conditions in fish. Proposed wastewater holding reservoir (s) (if they contain fish) could create stress conditions in fish if the water is drawn down to a low level in the summer months. This would crowd fish together into localized areas, and increase the chance of diseases and parasites by direct contact. It could increase skin abrasions by physical contact which may lead to secondary infections.

In Site 42 if a holding reservoir were built in the foothill areas, care should be taken in selecting a site. Serious fish diseases could develop if fish are crowded in an area of the lake because of low water, especially where the organic load was high. This could lead to an oxygen sag because of oxygen demands by the decomposing organic material.

Remedial, Protective and Mitigation Measures: The location of wastewater holding reservoirs should be in such an area that would not strand fish in isolated pockets during low summer water levels.

Proper management of the fishery in wastewater holding reservoir (s). This will satisfy an unmet recreation demand, very little fishing.

y. Impact 25

The twenty-fifth impact would be an increase in fish diseases because of higher water termperatures of recovered wastewater and increased bacterial growth.

Discussion: Wastewater used for irrigation purposes in eastern Contra Costa County could increase the temperature of surface waters in this area. The increased bacterial growth associated with higher mean water temperatures and a heavier organic load could increase the potential for fish diseases in existing waterways (Clifton Court Forebay, California Aqueduct, and the Delta Mendota Canal) if wastewater is drained into these facilities.

The application of wastewater to the foothills in central Contra Costa County may result in an increase in the temperature of surface water during the winter season of these areas depending on wastewater temperature and amount of dilution (mainly farm ponds and intermittent streams). Increased mean water temperatures may stimulate bacterial growth of fish pathogens in these waters.

The construction of wastewater holding reservoir (s) could increase the disease incidence of fish. A reservoir with an irregular bottom may isolate fish during summer drawdown of water. The water temperature in these isolated pockets could increase considerably in the summer, especially if they are shallow. Bacterial growth could increase with the temperature rise, especially if there is a heavy organic load, and promote the growth of bacterial pathogens of fish.

Remedial, Protective and Mitigation Measures: Control temperature of the recovered wastewater to a level that would not significantly increase the temperature of existing waterways.

Construct wastewater holding reservoirs in such a manner to prevent the occurrence of shallow, isolated pockets.

z. Summary of Sensitive Areas

Figure V-B-2 delineates the location of environmentally "sensitive" areas in Site 42. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime

wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

The "sensitive" areas of Site 42 consist of: (1) Marsh Creek in Sub-Areas 42.2 and 42.4, (2) Kellogg and Brushy Creeks in Sub-Area 42.4, (3) the California Aqueduct and Bethany Reservoir, Delta Mendota Canal, and Clifton Court Forebay in Sub-Area 42.3, (4) two small recreational areas in Sub-Area 42.2 and one large one, Mt. Diablo State Park, in the western part of that sub-area, and the recreational area of the Clifton Court Forebay, and (5) the scenic highway area along the eastern perimeter of Sub-Area 42.4 and through Sub-Area 42.3, SR 4, J-4 (the Byron Highway.)

SECTION I

I. WASTEWATER LAND APPLICATION SITE 43: THE SAN JOAQUIN COUNTY - UNION AND ROBERTS ISLANDS AREA

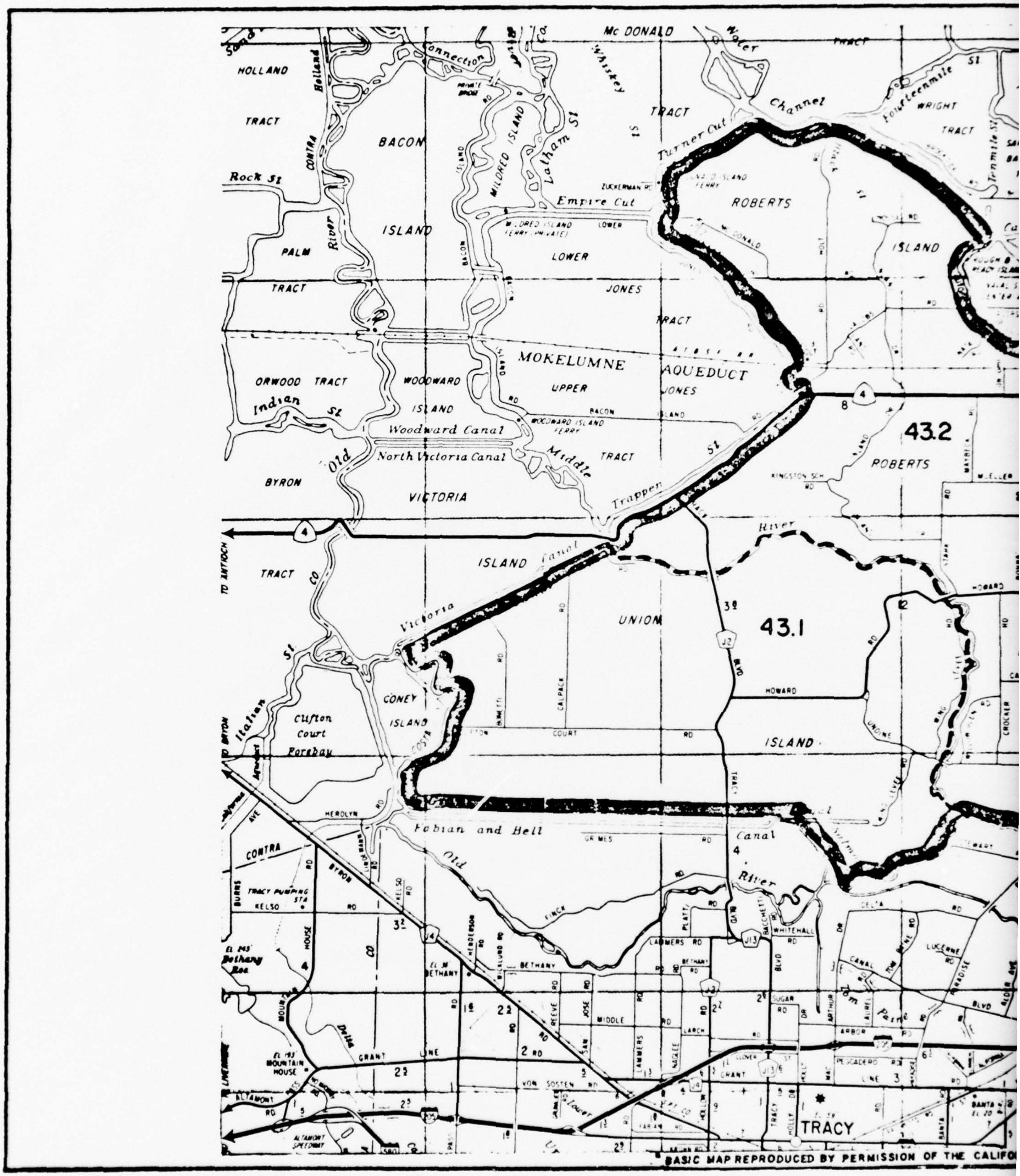
1 - Project Development

a. Present Land Uses

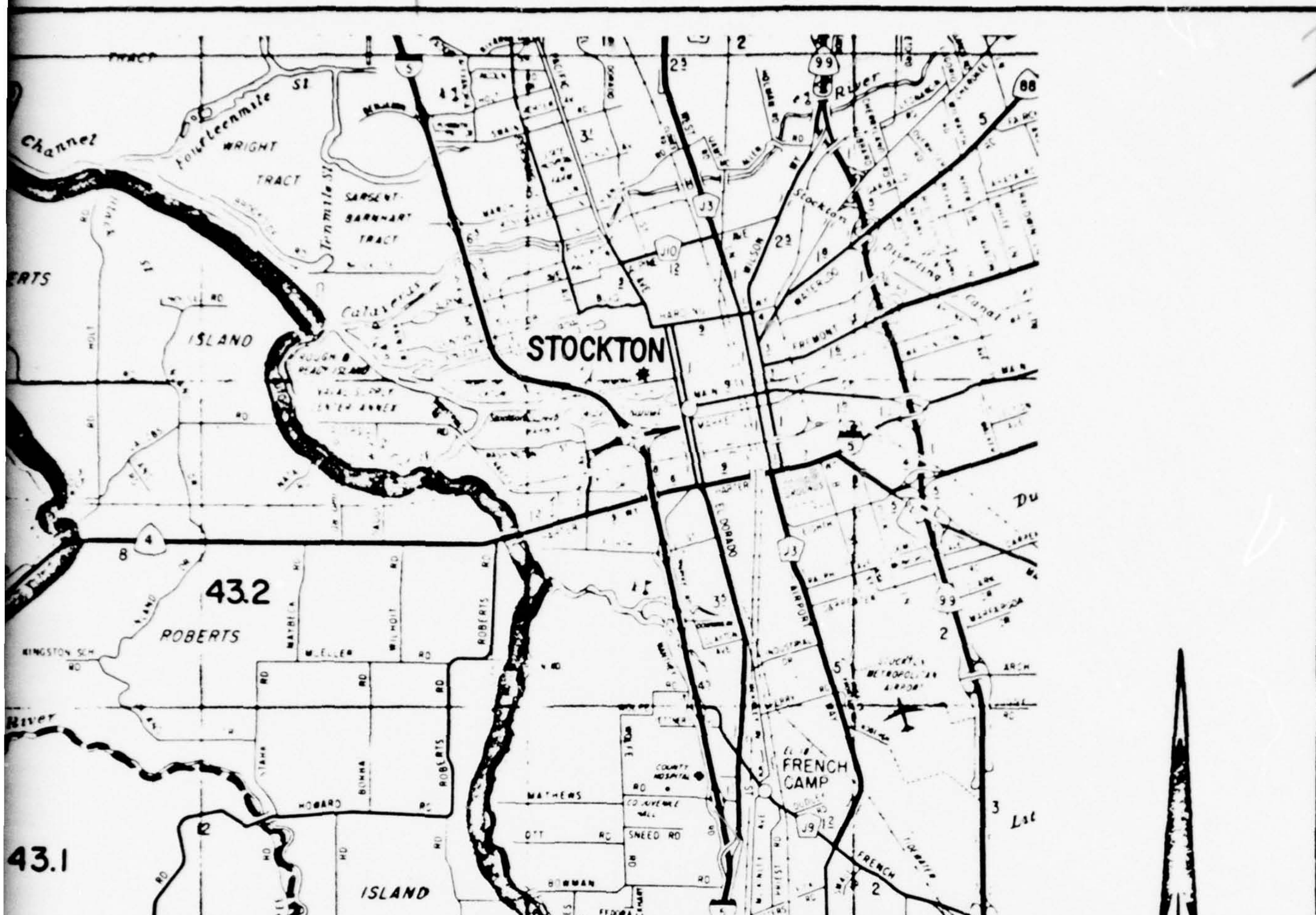
This site consists of Union and Roberts Islands in the central western part of San Joaquin County, situated in the southernmost part of the Sacramento-San Joaquin Delta. It is located immediately west and southwest of Stockton and north of Tracy. It is bound by the main channel of the San Joaquin River of the north and east; Old River and the Grant Line and Fabian and Bell Canals along the south, and Old River, Victoria and North Canals, Trapper and then Wiskey Sloughs, and Turner Cut along the western perimeter. The Middle River is the principal intersecting channel and separates Roberts Island from Union Island. The Site is representative of the large flat areas currently being formed in the Delta. See Figures V-I-1, V-B-2, and V-A-7.

The Site occupies 62,000 acres; Union Island covering 36,200 acres and Roberts Island 25,800 acres. Much of the land is at or below sea level and was claimed from tidal marsh lands. It is now maintained for agricultural purposes by levees and pump-out drainage systems. The area has a high water table which is expected to limit the vertical flow of any wastewater applied to the surface. The current method of irrigation and drainage involves (1) pumping out of groundwater, as necessary, in order to maintain the water table at desired subirrigation levels, with leaching to remove salt accumulations in crop root zones being accomplished by surface flooding and pumping drainage waters from shallow ditches back into the stream channels, and (2) surface application with water siphoned over adjacent channel banks and distributed by closely spaced shallow ditches with recovery with subsurface drains, collection ditches and channels, and pumping out from collection wells back into adjacent stream channels. The use of wastewater in this area could provide an excellent source of irrigation water as an alternative to river flow and pumping from wells. The nearest sources of wastewater are Antioch, Clayton, and Stockton, and Tracy.

Most of the Delta islands are leveed against the river and the winter floods. They contain primarily peat soils and are sinking each year as the peat tends to oxidize. Most of the general area is underlain with connate water. In addition, some of the deep aquifers are becoming more saline.



HOLLAND
TRACT
Mc DONALD
TRACT
Whiskey
Turner Cut
Channel
Fourteenmile
WRIGHT
TRACT
BACON
ISLAND
Rock Sl
Empire Cut
ROBERTS
ISLAND
PALM
TRACT
LOWER
JONES
TRACT
MOKELUMNE
AQUEDUCT
UPPER
JONES
ORWOOD TRACT
WOODWARD
ISLAND
Indian
Woodward Canal
North Victoria Canal
Middle
43.2
ROBERTS
BYRON
Old
VICTORIA
Trapper
ISLAND
Canal
TRACT
TO ANTIOCH
Victoria
UNION
43.1
HOWARD
COURT
RD
ISLAND
Italian
Clifton
Court
Forebay
CONEY
ISLAND
Fabian and Bell
Canal
Old
River
CONTRA
TRACY PUMPING STA
KELSO
BETHANY
MIDDLE
LAMMERS
GRANT
LINE
MOUNTAIN HOUSE
TRACY
ALTAMONT
BASIC MAP REPRODUCED BY PERMISSION OF THE CALIFO


STOCKTON
FRENCH CAMP
LATHROP
MANTECA
TRACY
43.2
43.1
ROBERTS
ISLAND
WRIGHT TRACT
Calaveras
Stewart
Paradise
Wetherbee Lake
Paradise Dam
MOSSDALE WYE
COUNTY HOSPITAL
SCALE IN MILES

The San Joaquin River and the other rivers that cross through this area have serious water quality problems now, particularly in dissolved oxygen, so that discharges from a wastewater system would have to be of high quality to avoid compounding existing problems.

The proposed Peripheral Canal will come through this area and will transport fresh water to the Clifton Court forebay from the Sacramento River. It is intended that it would have some outlets to provide fresh water inflows into the Delta. Any new water importation schemes will have to demonstrate that the water quality will not be further deteriorated.

A major plan for the drainage of the area to the south of Site 43 incorporates the San Joaquin Master Drain or the San Luis Drain. This project proposes to collect the sub-drainage water from irrigated lands in the San Joaquin Valley, transport it to the Delta, and, after adequate treatment to reduce deleterious substances, discharge into the estuary. Present plans locate the outfall in the vicinity of Antioch. A test facility at Firebaugh has been in operation for about two years in an effort to determine what level of treatment is required for agricultural wastewater.

b. Development Objectives

This Site was selected because it is reasonably representative of many of the Delta islands. The entire site is presently devoted to agriculture and is suitable for wastewater application. Proposed land uses and types of land application based on soil capabilities are shown in Figure V-B-3. Recommended unit wastewater application rates for the proposed and potential land uses are as follows: (1) for pasture, 4.3 acre-feet/acre/year for vegetation, 0.5 af/a/yr for leaching; (2) for crops, 2.6 af/a/yr for vegetation, 0.8 af/a/yr for leaching; and (3) for marsh grass rapid infiltration areas, 90 af/a/yr (from Table V-A-6). The analysis of potential vegetative cover in relation to specific soil associations is given in Table V-A-10.

The most probable sources of treated wastewater for land application are from metropolitan Stockton to the northeast, from the metropolitan Sacramento area and several small Delta communities such as Rio Vista and Isleton to the north, from the Manteca urbanized area to the southeast, from the urbanized Tracy area to the south, and possibly from the urbanized Contra Costa northshore area of Pittsburgh-Antioch and from Brentwood, Oakley, and Bryon to the west and northwest. The specific combination of sources will depend upon the degree of regionalization in the collection and treatment of wastewaters is thought advisable. The quality of these treated wastewaters to be applied can be extrapolated from the data in Table V-A-5 and by noting the counties of origin of these various possible sources.

The main point of input of treated wastewaters will probably be from the direction of the Stockton area. This assumes significant regionalization of secondary-level treatment facilities. It is proposed that the principal points of entry into the Site be along State Route 4 at either the west or northeast side for sources from these directions, along Tracy Road for sources from the south, and along Bowman Road for sources from the Lathrop-Manteca area. It is further proposed that distribution lines be located in convenient alignments within the existing rights-of-way of the existing road system, including the levee roads completely encircling the two islands. There are no topographic constraints for such alignments. This approach will facilitate easy distribution to the various parcels, all of which are accessible by this means.

It is also proposed that land application systems for this site would use the existing irrigation system which covers the entire Site. Substantial areas in Site 43 could be surface irrigated. The distribution and recovery systems will follow the management and development outlines presented in Section A-7a, A-7b, and A-7c.

Site 43 lies wholly within the Sacramento-San Joaquin Delta, a distinctive physiographic region of the Central Valley geomorphic province. The Study Site is characteristic of much of the easternmost portions of the Delta, an area of alluvial deposits lying between the maze of meandering major and minor channels. Elevations range from a high of about 11 feet in the southern part of Roberts Island to a low of -13 feet in the northernmost part of the island. The site very gently slopes to the west and to the north, slopes ranging from about 0.2 percent to practically nothing. The two islands are each enclosed in levees, top elevations ranging from a low of about 10 feet on the northwest perimeter to highs of 28 and 29 feet on the southeast perimeter and long portions of the Middle River. Figure V-I-2a and 2b show some typical views of the Site.

a. Geology and Hydrology

Summary of Geology: The basic subsurface formation consists of a thick accumulation of unconsolidated alluvial deposits. Most of this in Site 43 consists of terrestrial or basin deposits of primarily sedimentary rocks of late Quaternary age deposited during flood stages of major streams of the area between natural stream levees and fans, together with more recent stream deposits confined in narrow ribbons beneath the Middle River. Consolidated rocks lie beneath these deep deposits and they reflect adjacent Coast Range strata, particularly that of the Diablo Range to the west. (Background reference Section A-3b, Refs. 2,9.)

Summary of Hydrologic Systems and Water Quality Conditions: The surface water system in the area is a complex of freshwater tidal channels that vary seasonally in response to flooding and the pumping schedules at the pumps of the U.S. Bureau of Reclamation's Central Valley Project and the California State Department of Water Resources' California Water Project west of Tracy in the southeastern tip of Study Site 42. These pumps pull relatively low TDS (under 150 mg/l) Sacramento River water across the Delta. Along the San Joaquin River to the north, TDS levels range between 100 and 200 mg/l about 75 percent of the time with highs of about 460 mg/l being observed. Similarly, TDS levels range between 100 and 150 mg/l about 75 percent of the time along major sections of the Middle River inside the Site area with highs of about 330 mg/l being observed. Along the San Joaquin River on the east and the southern perimeter channels, TDS ranges evenly between about 110 to 550 mg/l, values over 300 mg/l being observed 50 percent of the time. The reported picture along the western perimeter is somewhat mixed. At

Site 43

2. Due E Up Clifton Court Rc
Road and Old River East L

1. View S from South Levee Road in Middle River
W of Tracy Road

5. SW Up Middle River from Bridg

4. WNW Across Union Island from Undine Road
Bridge Over Middle River

Site 43

Due E Up Clifton Court Road from Clifton Court Road and Old River East Levee Road

3. NW from Grant Line Canal Levee Road on Union Island

Up Middle River from Bridge

6. Robert's Island from West Levee Road of San Joaquin River S of Undine Road

7. S Up San Joaquin River

8. Robert's Island on West Levee Road of San Joaquin

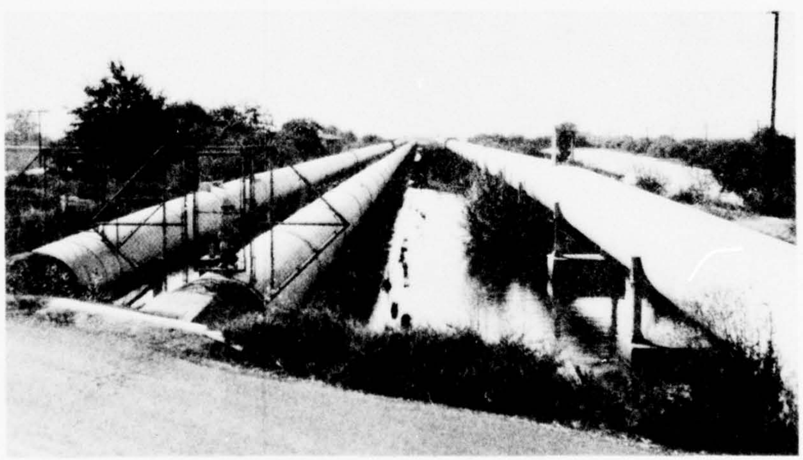
9. Grant Line Canal Looking W from Tracy Rd

2

Site 43

Up San Joaquin River

Levee Road of San Joaquin River just N of Undine Rd



10. Mokelumne Aqueduct Looking W from Holt Rd

Whiskey Slough at Holt, TDS ranges between 210 and 240 mg/l about half of the time and between 710 and 750 mg/l the other half. Further south at Middle River and SR 4, TDS values reportedly range between about 210 and 250 mg/l. The California Regional Water Quality Control Board (CRWQCB) for the Central Valley Region has specified a standard of 700 mg/l mean monthly for the eastern Delta channels. All but the northwesternmost tip of Roberts Island (below a line from Boulton Road at Whiskey Slough to the west end of Brookside Road just north of the San Joaquin River) and the western one-fifth of Union Island (east of a line from Middle River at SR 4 to just east of the intersection of Grant Line Canal with the Old River) are considered in the eastern Delta Estuarine hydrographic division. A somewhat lower but variable standard is specified, for example, for the Old River at Clifton Court Ferry. Estimates of other water quality parameters together with existing standards for same, where they have been established, are presented in Table V-I-1. Site 43 is also situated over a portion of the great Central Valley groundwater basin.

Water quality conditions in the San Joaquin River may be considered poor in the vicinity of Stockton during late summer because of depressed dissolved oxygen levels. Otherwise water quality is good to excellent except for turbidity. Examination of the records indicates a general increase in TDS levels over the years as would be expected in a region of intensive irrigated agriculture, stream flow controls, and out-of-basin water diversions. The completion of the Peripheral Canal, which would cut across the Study Site, if it comes to pass will have an uncertain impact on water quality conditions, depending mostly on the policy of water releases associated with this proposed project.

b. Soils

The soils of the Delta are generally peaty soils typical of areas whose natural and historical vegetative habitat is that of a tule marsh. The soils of Site 43 are very generally classified as non-calcic warm dry soils (Ref. 2). The mean annual soil temperature is greater than 47°F. Under natural conditions, they are continuously dry for long periods in the warm season. These soils are very deep and generally poorly drained. Top soils range in color from gray to pale brown; are varyingly acidic, with silty clay loam associations predominating. Subsoils range in color from very dark gray, through pale and light yellowish browns, to black; pH ranges from slightly acid to moderately alkaline (slightly acid to neutral predominating); and consist predominantly of 15-30 percent organic mucks and silty clay loams together with sandy loams, slightly calcareous clays, and minor amounts of 40-70 percent organic peaty mucks. Two-thirds of

Table V-I-1

CURRENT WATER QUALITY CONDITIONS AND STANDARDS FOR STUDY SITE 43

Water Quality Characteristic	Surface Waters 1/	Ground Waters 1/	Current Standards 2/
Total Dissolved Solids:		297-880	
East Delta	100-750 mg/l		700 mg/l monthly avg.
Central Delta	210-250 mg/l		500 mg/l monthly avg.
Electro-conductivity:			
(in microhms)	100-1000	560-1500	no numerical stds.
Total Hardness:	46-283 mg/l	138-269 mg/l	no numerical standards
Total Non-carbonate Hardness:	1-211	0-48	
Suspended Sediment	under 280ppm 3/		-
Turbidity:			
Central Delta	15-80 JTU		50 JTU
East Delta	13-100 JTU		150 JTU
Temperature:	32-82°F range 65-69°F median 3/	66°F	no numerical standards
pH:	7.0-8.5	7.7-8.2	6.5-8.5
Dissolved Oxygen:	2.8-14.8 mg/l		5.0 mg/l minimum
Total Nitrogen:			
East Delta	0.2-2.9 mg/l		3.0 mg/l
Central Delta	0.1-2.1 mg/l		1.0 mg/l
Total Phosphorus:	0.07-0.36		no numerical stds.
Ca:	10-35	41-70 mg/l	no numerical stds.
Mg:	5-30	9-26	no numerical stds.
Na:	10-112	20-243	no numerical stds.
K:	2-7	3.8-4.1	no numerical stds.
CO_3:	-	0.0	no numerical stds.
HCO_3:	56-216	163-551	no numerical stds.
SO_4	12-160	0-54	no numerical stds.
Cl:	10-200	32-391	no numerical stds.
B:	0.2-0.5	0-1.5	0.5 mg/l
SiO_2:	12-18		no numerical stds.
NO_3:		0.1-7.2	no numerical stds.
Heavy Metals:			
Cd	under 0.01 mg/l		0.01 mg/l
Cr	under 0.05		0.05
Cu	under 0.1-0.25		0.01
Fe	under 0.1-0.4		0.3
Pb	0.04-0.1		0.05
Mn	under 0.05		0.05
Zn	under 0.25-0.5		0.1

1/ from Hydrologic Data: 1969, Vol. II: Northeastern California, Bulletin No. 130-69, California State Department of Water Resources, May 1971

2/ from Ref. 183, surface waters only

3/ from Ref. 6

the Site's soils are classified in the Ryde-Egbert Association. More detailed soil information is presented in Tables V-A-2,3,9, and 10(Refs. 144, Section A-3c.)

c. Climatology and Meteorology

The climate of San Joaquin County is generally characterized by cool, rainy winters with tule fogs and hot, dry summers, the latter being modified by marine air masses that come through the Carquinez Straits from San Francisco Bay. The mean annual precipitation of Roberts Island is 11 inches while that for Union Island is somewhat higher, 13 inches. About 80 percent of the annual precipitation occurs between the months of November through March. Average air temperature in January is about 44^{O}F while that in July is between 72 and 74^{O}F. The average length of the growing season is about 290 days without a killing frost. Mean annual pan evaporation is 63.6 inches, about 70 percent taking place between May and September. Mean annual evapotranspiration from non-irrigated areas is about 11 to 13 inches. Potential evapotranspiration has been estimated to be about 44.6 inches per year while the annual vegetative requirement has been estimated to be about 37.9 inches per year for Roberts Island and 37.0 inches per year for Union Island (from Table V-A-4). Mean annual sunshine is between 3200 and 3400 hours per year (Refs. 2,6,144.)

Summary of Air Quality Conditions: It is estimated that Site 43 currently experiences between 30 to 50 days per year when the oxidant levels are at or over the 0.10 ppm level. Background discussion for this has been presented in Section A-3d. The site's proximity to Stockton and the continuation of current development rates would indicate that a general increase in these experiences with higher oxidant levels is to be expected. The degree to which current air pollution control programs, Federal, state, and local, will affect this in the immediate future period is uncertain. (Ref. 142.)

3 - Environmental Setting Without the Project: Ecological

The San Francisco and San Joaquin Delta contains important fish, wildlife, and recreational areas. Site 43 is representative of Delta flatlands. The Delta has a valuable striped bass and warmwater sport fishery. It is a necessary spawning area and migratory route for anadromous fish. It provides extensive native riparian habitat for a great diversity of birds and mammals. There are fallow agricultural lands that are necessary wintering grounds for waterfowl and it is heavily utilized for recreation for a variety of purposes. The Delta is classified as a Class I premium scenic, fishery, wildlife, and recreational waterway in the California Protected Waterways Plan. In summary, it is one of the most complex and valuable fish and wildlife areas in the state. It is also the most intensively studied area in California with respect to its aquatic resources.

a. Vegetative Cover

Wastewater Application Site 43 (Roberts and Union Islands) supports two vegetative cover types -- agricultural and riparian. The agricultural crops, orchards, fallow fields, roadways and home and farming developments cover all the available land (Figure V-I-3) except for the levees, berms, small canals, and "edges" in the study area. In the intense agricultural areas, native plant species are not permitted to grow. The "weedy" edges of fields and canals support species such as turkey mullin (*Eremocarpus setigerus*), sweet clover (*Melilotus* sp.), field mustard (*Brassica campestris*), Johnston grass (*Sorghum halepense*), as well as other species of grasses and composites (sunflowers). Some irrigation and drainage ditches contain cat-tails (*Typha* sp.) and large tules (*Scirpus* sp.). These species and others provide cover and food for native animals and the exotic ring-necked pheasant.

The channel islands, levees, berms, and other areas between levees and waterways constitute the major areas of existing native vegetation. Some of these areas are restricted by levee maintenance programs to having only small forbs and grasses. In other areas, dredger spoils, repeatedly deposited on the berms and levees, cover and restrict vegetation to annual species of forbs and grasses.

On channel islands, berms, and levees using less restrictive maintenance systems, permanent riparian vegetation (Table V-I-2) has developed. The plant species that develop generally depend on the amount of water available to the plant. Marsh plants such as cat-tails and bulrushes develop on areas where the land is shallowly submerged. Willow (*Salix*) species invade the slightly higher ground. Areas above

Figure V-I-3

EXISTING VEGETATIVE COVER IN SITE 43

COVER TYPES

A	Agriculture (cultivated and pasture)
B	Barren
C	Coniferous
CB	Chaparral-mt. brush
GF	Grasses and forbs
H	Hardwoods
M	Marsh
SDS	Southern desert shrub
PJ	Pinyon-juniper
U	Urban
W	Water (lakes and reservoirs)

Table V-I-2

DOMINANT RIPARIAN VEGETATION OF WASTEWATER LAND APPLICATION STUDY SITE 43

Scientific Name	Common Name
Populus fremontii	Cotton wood
Juglans hindsii	Black walnut
Quercus lobata	Valley oak
Acer negundo ssp. californicus	Box elder
Salix hindsiana	Sandbar willow
Salix sp.	Willow
Sambucus mexicana	Elderberry
Nicotiana glauca	Tree tobacco
Datura meteloides	Jimson weed
Rubus ursinus	California blackberry
Rosa californica	Rose
Fraxinus latifolia	Oregon ash
Vitis californicus	Wild grape
Marrubium vulgare	Horehound
Melilotus sp.	Sweet clover
Brassica campestris	Field mustard
Mimulus sp.	Monkey flower
Centaurea melitensis	Star thistle
Arundo doxax	Giant reed
Eucaluptus sp.	Eucalyptus
Scirpus sp.	Bulrush (Tule)
Typha sp.	Cat-tail

the shallow water on berms and levees support tree species such as black walnut (Juglans hindsii), cottonwoods (Populus fremontii), ash (Fraxinus latifolia), box elder (Acer negundo ssp. californica), oak (Quercus lobata) and eucalyptus (Eucalyptus sp.). Levees in some areas are heavily covered with blackberries (Rubus ursinus), wild rose (Rosa californica), or giant reed (Arundo doxas). Elderberry (Sambucus mexicana), tree tobacco (Nicotiana glauca), monkey flower (Mimulus sp.), star thistle (Centaurea melitensis), Jimson weed (Datura meteloides), and horehound (Marrubium vulgare) are also common on the landward levee slopes. Some of the areas contain most of the species listed above, while at other locations a single species or a few species will be dominant.

Riparian and marsh areas of particular note include the central vegetative strip in between the Fabian and Bell Canal and the Grant Line Canal, and between Victoria Canal and North Canal; the channel islands of the San Joaquin River, Middle River, Old River, Trapper Slough, Whiskey Slough, Salmon Slough and Turner Cut; and some areas (particularly the wide inner berms) of the levees of Old, Middle, and the San Joaquin River. The south bank of Trapper Slough contains extensive marsh areas of cat-tails and bulrushes.

Several plant species reported in the area are listed as rare or endangered by the California Native Plant Society and are noted in Table V-I-3.

b. Fish and Wildlife

Fishery Resource: The many sloughs and canals on Union and Roberts Islands support a premium warmwater fishery. This area is also part of the migratory route of chinook salmon, which are currently endangered by low flow and poor water quality in the San Joaquin River. Bordering and internal sloughs and creeks contain many species of the family Centrachidae (sunfish and bass), Ictaluriade (catfishes), Cyprinidae (minnows), and Catostomidae (suckers). A complete list of fishes utilizing the study site is available in the Appendix (Chapter K).

Striped Bass. Major spawning migrations of striped bass enter the area in the spring. Those in the northern Delta migrate upstream into the Sacramento River. Those in the southern Delta concentrate in the lower San Joaquin River and migrate into the upper portions of the river if water quality is good. A high TDS (>400 mg/l) will prevent the upstream migration of adult bass (Ref. 100). Striped bass have been known to spawn in the San Joaquin River between Stockton and Mossdale, but do so only in years of heavy spring runoff

Table V-I-3

RARE, ENDANGERED AND POSSIBLY EXTINCT PLANTS OF WASTEWATER APPLICATION SITE 43

Scientific Name	Common Name	Local Habitat	Plant Community
Cirsium crassicaule	a thistle	Shallow water, wet places in fields near San Joaquin River	
Orcuttia greeni	a grass	Moist open places	Valley grassland
Eryngium racemosum	Button snakeroot (a forb)	Low wet places below 100 feet, San Joaquin Delta	Freshwater marsh

when the TDS is low. Very little spawning occurs in Grant Line Canal and Middle River.

American Shad. Adult shad are common from March through June in the main San Joaquin River channel (from Stockton to Mossdale) and the Fabian-Bell Canal. Most shad ascend branches of the San Joaquin River during this time to spawn, although some may spawn in the canals. Young shad and striped bass find the Delta to be an essential nursery area during their seaward migration. Channels bordering Site 43 are a part of the nursery area. Turner and Kelley (Ref. 100) reported catches of young shad in the Fabian-Bell Canal and in the main San Joaquin River between Mossdale and Stockton.

King Salmon. Adult salmon move from the Delta into the San Joaquin River and migrate upstream during the fall, and to a lesser extent, in the spring. Fall runs of salmon have been considerably lower since 1953. Young salmon migrate downstream through the Delta during the spring months, especially April to June. Juvenile salmon have been captured in Old River at Indian Slough, the Fabian-Bell Canal, and in the main San Joaquin River near Stockton (Ref. 100). They are commonly taken at the Tracy and Clifton Court pumps.

White Sturgeon. Juvenile white sturgeon have been caught in small numbers in the spring near Mossdale on the main San Joaquin River.

Catfish. The Sacramento-San Joaquin Delta provides over one-half of the catfish caught by sport fishermen in the state. Each species of catfish occupies a different environment in the Delta. Black and brown bullheads occur most abundantly in dead-end sloughs. Channel catfish prefer the swifter waters of the San Joaquin River. Adult white catfish are more abundant in quiet backwater sloughs and flooded islands, such as Trapper and Whiskey Sloughs.

Sunfish. The major concentrations of Centrachids (sunfish) are found in quiet backwater sloughs off the main channels.

Cyprinid Fish. Members of the Cyprinidae include the Sacramento blackfish, Sacramento hitch, splittail, Sacramento squawfish, common carp, goldfish, and golden shiner. Carp, Sacramento blackfish, and Sacramento hitch are extremely abundant around Mossdale, on the main San Joaquin River, especially when the TDS is very high. Goldfish and golden shiner are mainly caught in dead-end sloughs. Splittail appear to be evenly distributed throughout the Delta. The Sacramento

squawfish prefer river drainage. Cyprinids, Centrarchids, and bullheads commonly inhabit drainage canals on the irrigated lands.

Wildlife: Site 43 has prime wildlife habitat in the riparian zones along waterways, in the marshes and sloughs of the channel islands, and to a limited extent in the agricultural areas covering most of the area.

The number and diversity of animal species in Site 43 can be appreciated from the species lists in the Appendix (Chapter K). The habitat, distribution and general position in food webs is also given for each species. The relative abundance of faunal species is known for economically important species, i.e., game species, while the relative abundance of most non-game species awaits investigation. The faunal species observed during the field survey are listed in Table V-I-4.

Upland Game. San Joaquin County rates in the first ten of the state for hunter bag of pheasants, doves, and jackrabbits. Pheasants occur in densities of 64 to 320 per square mile in the agricultural areas, especially in grain and corn fields with "weedy" edges.

Quail are estimated to occur in densities of 190 to 380 per square mile on the brushy levees and berms along the rivers, sloughs, and canals. Many of the "land side" levees contained dense growths of blackberry and wildrose bushes which provide excellent cover for quail.

Waterfowl. San Joaquin County is an important waterfowl wintering area, and consistently rates in the top ten in hunter bag of ducks and geese. Fallow grain fields are important feeding and loafing areas for ducks, geese and cranes during the winter. The non-leveed channel islands (unreclaimed) with their dense vegetation of cat-tails, bulrush, brush and trees, provide the highest quality of nesting, roosting and cover.

Non-game Wildlife. Beaver and otter are common and muskrats are plentiful in and along the waterways of Site 43. According to the Game Management Handbook, about $30,000 worth of pelts from fur-bearing animals, especially beaver, mink and muskrat, are taken annually along the Delta. Some of these animals are taken from the sloughs and marshes of Site 43.

The segment of the greater sandhill crane population that winters in the Sacramento-San Joaquin Delta numbers 2,000 to 3,000 individuals. Fallow grain fields and marshes are important winter habitat for cranes.

Table V-I-4

ANIMALS OBSERVED DURING FIELD INVESTIGATIONS ON OCTOBER 3, 1972 OF WASTEWATER LAND APPLICATION STUDY SITE 43

Birds	Mammals
* American kestrel	California ground squirrel
Cooper's hawk	Scat identification of
Red tailed hawk	brush rabbit, raccoon,
Turkey vulture	and coyote.
Meadow lark	
Song sparrow	
* White crown sparrow	
Fox sparrow	
Belted kingfisher	
* Red shafted flicker	
Brown towhee	
Western wood peewee	
* House finch	
* Mockingbird	
Scrub jay	
* Brewer's blackbird	
* Red-winged blackbird	
Rufous hummingbird	
Loggerhead shrike	
California valley quail	
Chinese ringnecked pheasant	
California gull	
Starling	
Ruddy duck	
Killdeer	
Mourning dove	
Common gallinule	
Purple martin	
Barn swallow	
Cliff swallow	
Great blue heron	

* These species were omnipresent in the area.

Rare and Endangered Species:

Fish. One fully protected fish species may occur in Site 43, the thicktail chub. Its status is not presently known except that it inhabits the lower reaches of the Sacramento-San Joaquin River drainages.

Reptiles. Two rare or endangered reptilian species occur within Site 43:

Species	Status
Alameda striped racer	Rare
Giant garter snake	Uncertain and rare

The Alameda striped racer inhabits the lowland mountainous areas and rocky outcroppings east of San Francisco Bay and is occasionally found in grasslands. Brushy levees and berms would be the likely habitat for this animal in Site 43. The giant garter snake inhabits freshwater marshes and sloughs. Its habitat has been greatly reduced by diking and filling of marshes.

Birds. Several raptorial bird species are known to occur in or near Site 43 (see the Appendix, Chapter K).

Species	Status
Ferruginous hawk	Uncertain
Southern bald eagle	Endangered
American osprey	Uncertain
Prairie falcon	Rare
American peregrine falcon	Endangered

All of the above bird species share the common trait of being "end of the chain" predators. They live almost entirely on animal flesh. Their numbers have been reduced by destruction of habitat, depredation by man, and accumulative effects of pesticides. Residual pesticides, especially chlorinated hydrocarbons, accumulate in the tissue of prey animals and they are then passed upwards through the food chain, accumulating in the highest concentrations in predators. Chlorinated hydrocarbons are believed to inhibit reproduction success (Ref. 36). Other bird species that may utilize the marsh and riparian habitat are:

Species	Status
Greater sandhill crane	Rare
Alaskan short-billed dowitcher	Uncertain
California yellow billed cuckoo	Rare
Yakutat fox sparrow	Uncertain
Suisun song sparrow	Uncertain

The greater sandhill crane utilizes the fallow grain fields for loafing and feeding areas during its southward migration. The Alaskan short-billed dowitcher winters from Central California south. Its habitat consists of mudflats, open marshes, and ponds. It feeds on small invertebrates in mudflats. The California yellow-billed cuckoo inhabits dense streamside plant growth, especially in willow thickets, feeding primarily on insects, berries, and reptiles.

The Yakutat fox sparrow probably winters in the central valley of California, utilizing riparian vegetation. The Suisun song sparrow is probably a resident bird inhabiting marshes, thickets, and roadside brush.

Wildlife Diseases: Avian cholera is an enzootic disease of waterfowl on all of the southern Delta islands including those of Area 43 (Ref. 112). During the winter thousands of swans, geese, and ducks reside in the area. An aerial survey of Union and Roberts Islands in February 1971, followed by a ground census revealed that about 400 swans, 2,700 geese and 3,100 ducks had died of avian cholera. Based on hunter postcard surveys, more geese died of this disease than were killed by hunters on these islands (Ref. 113).

The projected wastewater application for optimum vegetative growth indicates that the crop and site requirements are zero during December, January, and February. However, application of wastewater for a flushing action throughout these winter months could have a beneficial effect described for Site 4 regarding control of avian cholera. Again, contour ponding in this period for maximum water control and the use of pumps to discharge the water from a lower sump into the San Joaquin and Middle Rivers would provide a positive means of disease control.

Rapid drainage and drying of the lands on Site 43 would also have a beneficial effect on the course of an avian cholera outbreak. This action is a normal procedure and is necessary so that the ground can be disked and the soil prepared for planting operations. If the suggested flushing procedures could be followed by rapid drainage in mid-February

or at the end of the month, dependent on the amount of local precipitation, there would be a beneficial impact on the wintering waterfowl as far as avian cholera is concerned.

Aspergillosis is an enzootic disease of waterfowl frequenting the Delta islands. This disease is contracted by the ingestion of moldy corn wherein the spores of the fungus Aspergillus fumigatus are inhaled with subsequent development of hyphae in the lungs and air sacs of the birds (Ref. 114). The mortality rate is high in afflicted waterfowl and annually between several hundred and a thousand of the waterfowl population die. Since corn is one of the most predominant crops of the area, and this fungus is ubiquitous where moisture and moderate temperatures prevail, aspergillosis will continue to take a toll of waterfowl. Discharge of wastewater for flood irrigation of crops on Site 43 should have neither an adverse nor beneficial impact on the course of aspergillosis.

Continued management practices for existing crops with supplemental application of wastewater will not influence the occurrence of botulism which is infrequent and relatively unimportant on Site 43.

No other wildlife disease problems are known or are anticipated for Site 43.

c. Ecological Systems

The major animal communities in Area 43 are located in the marsh land and riparian habitats along the major rivers, sloughs, and canals. The remaining land area is agricultural. The riparian habitat occurring on berms and levees and the marshy areas in sloughs provide the important cover for resident wildlife.

Marshes: Trapper and Whiskey Sloughs provided the most extensive marsh areas in Site 43. Bulrush and cat-tails were common marsh plants observed. No waterfowl were observed in the marshes, but this was probably due to the limited amount of observation time and the time of year. Both marsh areas are prime wildlife habitats, providing cover for waterfowl, non-game waterbirds, and mammals. Marsh habitat is of special importance and critical because of its limited acreage in California.

Riparian Habitat. Riparian habitat is found on the levees and berms of the San Joaquin River and associated sloughs and canals, except those that have been cleared for levee maintenance. Some of the areas visited during the field study include San Joaquin River below

Bowan Road and near the southern end of Undine Road, Middle River near Howard Road, Grant Line and Fabian Canals at Tracy Boulevard, and Old River at Clifton Court Road and Calpack Road. The riparian vegetation varied from impenetrable giant reed stands to areas consisting of trees, woody shrubs, and annual and perennial plants. The latter areas (providing a variety of plant species) supported the most diversified types of wildlife. This is the best habitat for song birds and good nesting habitat for raptors, e.g., white-tailed kites and red-tailed hawks. Blackberry and wild rose patches were common, many times on the land side of levees. These areas provide excellent cover and food for California valley quail. Animal trails were found on some berm and levee areas where the brush was not impenetrable. Scat identification indicated the animals were probably brush or cottontail rabbits, raccoons, and coyotes.

Agricultural Lands: Cultivated land occupied the majority of Site 43. These lands provide forage areas for large raptorial birds and some game birds. Pheasants were observed in corn fields and near alfalfa fields. Farm practices and cropping patterns are critical in pheasant habitat. Irrigated pasture, rice land and irrigated cereal crops are vital to pheasant populations. Intensive, clean farming practices are unfavorable to pheasants (California Fish and Wildlife Plan, 1965, Ref. 32). Fallow farm land was scattered throughout the area, interspersed between alfalfa and asparagus. These areas providing loafing ground for geese and cranes during the winter.

The marshes observed are of the utmost importance in providing cover for migratory waterfowl, resident waterbirds, and marsh associated mammals (beaver, muskrat, mink, and otter). The reduction of any portion of the marsh acreage would undoubtedly result in a decline in populations of associated birds and mammals. The riparian habitat that best supports birds and wildlife is that which is comprised of a mixture of trees, brush, and animal plants, with occasional patches of dense brush and clearings. Irrigated agricultural land, especially those with cereal grains, support the entire life cycle of Chinese ring-necked pheasants. Agricultural areas also serve as forage areas for birds and raptors that require the riparian habitat for "homes".

d. Recreational Resources

The gross recreational user potential available to the area was determined to be 265 million visitor-days per year. The area is, in fact, heavily used although extent of use was not determined.

The area supports an excellent fishery including striped bass, salmon, and sturgeon. Also excellent warmwater fishing for catfish and largemouth bass is available.

Extremely good duck and pheasant hunting is found in the area as well as hunting for doves, rabbits, and quail.

Of special note in the area is the uncommonly fine opportunity for wildlife observation, nature walks, water skiing, and boat trips. This area represents a rare and valuable marsh land and riparian habitat which is unique in both its quality and scope. The proximity of this area to three major population centers represents an opportunity to provide a high quality natural experience to a large number of recreationists. A large amount of recreation is provided by commercial facilities while public facilities are extremely limited.

Present Public Facilities: The Stockton public boat launching ramp on the Stockton Deepwater Channel and the Dos Reis Road public ramp are the only public recreation facilities within study Site 43. Both offer launching ramps and limited parking at present. The Dos Reis site is scheduled for future development by the state and county. There are no public operated hunting areas within the site and most land is privately owned so little land is available for hunting by the general public.

Present Private Facilities: Private recreational facilities on Site 43 are almost exclusively boat harbors, docks, and marinas. These are scattered along the perimeter waterways of Roberts and Union Islands and vary greatly in numbers and types of facilities available. A list of the landings and their individual services is shown in Table V-I-5.

Hunter and Angler Use: Hunter and angler use data are seldom kept for small specific areas like Site 43, especially if the area lacks publicly owned and operated hunting and fishing sites. Estimates of use over larger areas are, however, quite often available and may at least express a trend in use for the lands surrounding a specific site. This is true in the case of Site 43. Stanford Research Institute has estimated hunting and angling use within the Sacramento-San Joaquin Delta from 1960-2020. The following figures (Table V-I-6) can be used to estimate the growth rate of hunting and fishing on Site 43 even though they represent median estimates for the entire delta.

The California Department of Fish and Game's 1970 hunter survey offers hunting use data for San Joaquin County, an area slightly more specific than the Delta as a whole, but still not complete representative of the study area. Table V-I-7 presents data extrapolated from a post-season two percent hunter survey of San Joaquin County.

Table V-I-5

PRIVATE BOAT LANDINGS IN SITE 43*

	Launching	Berths	Mooring	Dry-storage	Accommodations	Camping	Picnic	Trailer
Fabian and Bell Canal								
Jack's Fishing Resort	x	x		x				
Oasis Marina	x	x		x			x	x
Middle River								
Union Pt. Fishing Resort		x						
Whiskey Slough								
Whiskey Slough Resort	x	x						
San Joaquin River								
Changing Tide Fishing Resort		x			x	x	x	x
Todd's River Club	x	x				x	x	x
Turner Cut-Roberts Tract								
Ehrich's Fishing Resort		x		x	x			
Lost Isles Club		x					x	
Tiki Lagun	x	x		x				
Turner Cut Resort		x		x	x	x	x	x
Windmill Cove	x	x			x		x	x
Stockton Deepwater Channel								
The Anchorage		x						
Bert's Boat Harbor	x	x						
Habeeb Boat Harbor		x						
Ladd's Stockton Marina	x	x						
Louis Park	x							
New Marine Service	x	x						
Port of Stockton Boaters			x			x	x	
Stephens Marine, Inc.	x	x		x				
Stockton Rod & Gun Club	x	x					x	
Uptown Yacht Harbor		x			x			

* Adapted from Ref. 41

Table V-I-6

HUNTING AND FISHING USE IN THE SACRAMENTO-SAN JOAQUIN DELTA
1960 - 2020

Mean Estimates in Thousands of Participation Days*

Fishing	1960	1970	1980	1990	2000	2101	2020
Striped bass	786	1,137	1,383	1,834	2,159	2,600	2,870
Catfish	448	612	732	996	1,238	1,491	1,646
Largemouth black bass	11	15	18	24	30	37	40
Unidentified delta angling	79	108	129	176	218	263	290
Total Fishing	1,324	1,882	2,262	3,030	3,645	4,391	4,846
Waterfowl Hunting	23	21	22	22	22	22	23
Total Hunting and Fishing	1,357	1,903	2,284	3,052	3,667	4,413	4,869

*Adapted from Ref. 21

Table V-I-7

1970 HUNTER SURVEY - SAN JOAQUIN COUNTY*

	Bag	Hunters
Pheasant	39,300	17,000
Quail	34,600	4,700
Dove	103,400	9,400
Pigeon	800	200
Jackrabbit	58,400	6,300
Cottontail	8,400	1,200
Tree squirrel	1,200	100
Ducks	67,800	6,800
Geese	6,400	2,700
Jacksnipe	200	200
Coots	8,600	1,100
Deer	-0-	100

*Extracted from unpublished Dept. of Fish and Game data sheets, Sacramento, California

There are no organized public or private hunting lands on Roberts or Union Islands. Publicly owned lands are minimal and private landowners have preferred not to develop their agricultural lands into private shooting areas. Individual owners do occasionally flood their fields in winter for personal waterfowl hunting use, especially on Union Island, but there are no organized clubs (Ref. 48).

Open Space: The current San Joaquin County General Plan categorizes all of Site 43 as agricultural, recreational, and conservation open space, excepting a small area of institutional land immediately west of the San Joaquin River (Stockton sewage treatment oxidation ponds). The conservation areas are limited to the levees along the San Joaquin River, Old River, Grant Line Canal, Victoria Canal, Middle River, and Whiskey Slough. They are categorized as such so that they may be maintained in natural vegetation. The banks of Turner Cut, Burns Cutoff, and the Stockton Deepwater Channel are listed as recreation land and have good public road access. The remaining interior portion of the island is agricultural open space (Ref. 85). A new open space element to the county general plan is currently being written. San Joaquin County wishes to maintain the open space status of Site 43, as it is prime agricultural and recreational land (Ref. 104).

Future Public Facilities: Both the state and county have proposed additional recreational development for Roberts and Union Islands and their surrounding waterways. Plans for the State Peripheral Canal, which would pass through the center of the study area from the Stockton Deepwater Channel to Clifton Court Tract, include canalside recreation areas. These areas would include facilities for picnicking, swimming, camping, boating, and waterskiing. The exact numbers and locations of these facilities are still in the planning stage as part of the Sacramento-San Joaquin Delta Master Recreaton Plan of the State Resources Agency. Development of aquatic parkways along the San Joaquin River, the Stockton Deepwater Channel and Fabian-Bell Canal are included in this master recreation plan.

The state has also proposed the development of an Old River Islands State Recreation Area along the easterly end of Fabian-Bell Canal at Old River and Paradise Cut. This 980-acre park was authorized in 1965, but due to lack of funds the land has not yet been purchased. Table V-I-8 presents a listing of expected facilities.

Table V-I-8

PLANNED FACILITIES FOR A PROPOSED OLD RIVER ISLAND STATE RECREATION AREA*

Facility	First 5 Years	Next 15 Years	Total
Camp Sites (Boat Access)	75 units		75 units
Camp Sites (Auto and Boat Access)	50 units	50 units	100 units
Picnic Sites (Boat Access)	40 units	150 units	190 units
Picnic Sites (Auto Access)	80 units	60 units	140 units
Group Area		1 each	1 each
General Parking	230 spaces		230 spaces
Launching Ramps	4 lanes		4 lanes
Bicycle and Hiking Trails	4.5 miles	4.5 miles	9 miles

*Adapted from Ref. 29

A final state recreational development would establish a conservation area to protect wildlife and fisheries along Middle River from the San Joaquin River to SR 4.

Several angling access areas are planned as joint state and county projects. The Dos Reis Road site was mentioned above as an existing boat launching ramp. Additional parking, picnicking and playground facilities are being developed adjacent to the ramp as Robert Allen Park. Two other angling access sites are proposed adjacent to Site 43, one at Clifton Court Ferry and one at the junction of Middle River and SR 4. Similar recreational facilities are expected at these two sites.

San Joaquin County itself has plans for several water-oriented recreational parks within the study area. Tracy Marina will be established at the junction of Fabian-Bell Canal and Old River at Clifton Court Forebay. A harbor, boat launching ramps, berthing, picnic sites, camping area, playgrounds, and parking will all be available. Buckley Cove on the Stockton Deepwater Channel is scheduled for development as a small craft

harbor with yacht berthing, snack bar, restaurant, and club room facilities. Also on the Deepwater Channel, Black Slough Landing Park with picnicking, camping, swimming, and small harbor is scheduled for construction. Trapper Slough Roadside Park is the final county-operated proposal. It will be located on the north bank of the slough between Holt and Middle River and will be strictly a roadside rest area.

In addition to parks, the county has proposed a system of recreation roads and hiking and riding trails. The recreation roads would provide access to river and slough recreation areas that are at present inaccessible. There are four stretches proposed within Site 43: (1) south of Fabian-Bell Canal from proposed Old River Islands State Recreation Area to Clifton Court Forebay, (2) immediately north of and parallel to Clifton Court Road from Tracy Road to Old River, (3) south of Trapper Slough from its junction with Middle River along Whiskey Slough and Turner Cut to Holt Road, and (4) along the proposed Peripheral Canal from the Stockton Deepwater Channel to SR 4. A riding and hiking trail will also be established through the area, entering along Bowman Road from the east, then passing north along Roberts Road and west along Howard Road to Tracy Road, whereupon it will turn south out of the area.

e. Protected Waterways Designation

The Sacramento-San Joaquin Delta is classified as a Class I premium scenic, fishery, wildlife, and recreational waterway in the California Protected Waterways Plan (Initial Element, 1971). It is classified as a Class I striped bass and sturgeon water in the listing of extraordinary fishery waterways. The Delta is also classified as a Class II salmon fishery and a Class III fishery for American shad (in "good" water years). The Delta Master Recreation Plan (1966) recommends that "all of the channel islands and adjacent levees in that portion of Old River bounded by Coney and Union Islands" be designated as a "fish and wildlife area". Other waterways within Site 43 are designated as "protected use" or "natural use" areas.

San Joaquin County recommended nine other waterways in or bordering on Site 43 for consideration in the California Protected Waterways Plan. They are as follows:

Old River - San Joaquin River
Middle River - from Old River to San Joaquin River
Grant Line and Fabian-Bell Canals - from Salmon Slough to Old River

Woodward Canal and North Victoria Canal - between Middle River and Old River
Victoria Canal - from Middle River to Old River
Trapper Slough - entire slough
Whiskey Slough - entire slough
Salmon Slough - from Old River to Fabian-Bell Canal
Paradise Cut - San Joaquin River to Old River

a. Archaeological and Historic Site Locations

It has been estimated that Site 43 has the greatest archaeological potential of all the sites studied in this report (Ref. 11). The Delta area between Stockton and Sacramento has produced occupation sites dating back 3000 years. Site 43's proximity to this archaeologically productive region and its drainage system, in light of the high probability of a prevailing fishing economy for the area's primitive antecedent inhabitants, indicate this great potential. Scattered site surveys have reportedly been productive (Ref. 11). Subsequent documentary surveys have revealed a total of 10 prehistoric ethnographic sites within Site 43, and five immediately adjacent to it (Refs. 131, 132, 133, 134, 135, 138, and 139). More specific location of these sites relative to Figure V-I-1 has been extremely difficult. Sites of Indian occupation have been recorded as early as 1806 by the Moraga expedition (Ref. 133). A Barr Collection in the Smithsonian Institute of Washington, D.C. contains artifacts from over 300 sites known to be in the general region of Site 43 in 1898 (Ref. 135). The Indians encountered by the early Spanish explorers in this area were the Cholbones, a northern extension of the Yokuts. Their foraging economy was largely dependent upon fishing. It is estimated that their occupation of the Delta probably goes back about 1000 years.

There apparently are no significant historical landmarks within Site 43, and certainly none registered with the State of California (Refs. 11 and 15). The reported "Zinc House on French Camp Road" is clearly associated with a location way to the east of the Study Site (Ref. 11.) Subsequent documentary surveys have revealed a total of 20 mentioned historical sites (Refs. 136, 137, and 138). Most of these are associated with the early history of San Joaquin County and indicate landings on the San Joaquin River and several other of the area's channels and the home sites of early settler farmers. Apparently little remains of these earliest farm site structures and landings facilities. What primarily remain are place and site names, such as Clifton Court Ferry and McDonald Island Ferry.

b. Scenic Locations

Site 43 in its entirety is an officially designated scenic area by virtue of it being within the legally defined Sacramento-San Joaquin Delta. The entire Sacramento-San Joaquin Delta and Marsh is classified as a

premium (Class I) scenic and recreational waterway under the California Protected Waterways Plan (see Section A-3e). The Old River, which provides part of the Study Site's southern perimeter, is recognized separately for its scenic character. SR 4 is the only state highway passing through Site 43 and it has not been designated in this area as being part of the State Scenic Highway System nor is such designation being proposed.

Apart from official scenic designations, the scenic value of several of the waterways within and along the perimeter of Site 43 deserves some further comment at this point. Old River along the east side of Coney Island (along the western perimeter of Union Island), Middle River, Trapper Slough, and Turner Cut all exhibit lush riparian growth along their banks. In many instances this vegetation completely blocks the surrounding agricultural lands from the view of the waterborne traveler, thus providing a scenic atmosphere unique to the Delta.

These scenic values are more than somewhat marred by the ever present appearance of roadside refuse scattered all along the edges of the Study Site's roads and particularly along the levee roads and the many stopping and pull-off viewing and mini-picnicking areas adjacent to them. The universal "indicator" of this is the beer can.

Some idea of the scenic values of Site 43 can be anticipated in some of the views presented in Figures V-I-2a and 2b.

5 - Environmental Setting Without the Project: Public Health

(Refer to Volume VI: TECHNICAL APPENDIX -
THE PUBLIC HEALTH IMPLICATIONS OF LAND
APPLICATION OF WASTEWATER AND RESIDUAL SOLIDS)

6 - Environmental Impacts

a. Impact 1

The first impact of wastewater land application would be the loss of vegetation, wildlife habitat, and wildlife on spoil areas.

Discussion and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 13 of Site 4 (Section B-6m).

b. Impact 2

The second impact would be the loss of wildlife species through loss of habitat (lands, vegetation) to project facilities.

Discussion and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 5 of Site 4 (Section B-6e).

c. Impact 3

The third impact would be the loss of wild land habitat permanently committed to pumping stations, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.

Discussion and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 12 for Site 4 (Section B-6l).

d. Impact 4

The fourth impact would be a change in the species association because of the change in land use produced by the introduction of additional moisture.

Discussion: A portion of 43.1 is recommended to be converted to pasture (it is now crop land) by the addition of approximately 2 acre-feet per acre per year of treated wastewater. Another portion of section 43.1 is to be converted to a rapid infiltration (marsh area) by the addition of large quantities of wastewaters.

Remedial, Protective and Mitigation Measures: A change in ecosystems would produce a direct loss of the existing flora and fauna, while gaining a new species association on the newly developing habitat. The loss

of the flora and fauna (depends on the present ecosystem) of one ecosystem cannot be mitigated. Mitigation, protective and remedial measures would need to be taken only if the original ecosystem was to be maintained. To lessen the changes to the ecosystem, less wastewater would have to be applied. Animal species that would be affected by a change in ecosystems can be ascertained from the species list in the Appendix (Chapter K) by examining the habitat and food habits column of these tables. For example, the fallow (seasonally cropped) fields which now provide loafing and feeding areas for geese would be converted to green pasture; a less preferential area for geese. In order to determine what would be lost, each small individual area with its associated flora and fauna would have to be evaluated in light of a full water application schedule.

The creation of marsh lands, while an adverse impact for the agricultural associated wildlife on the pre-existing cropland, will provide habitat for the many species which are dependent on a marsh environment. As marsh lands statewide have been seriously reduced in acreage with the encroachment of man, production of permanent marsh habitat would be beneficial and a valuable ecosystem.

Some lands within Site 43 are flooded during the winter months and support large populations of migration waterfowl. The creation of permanent marsh would provide cover habitat for some resident waterfowl and particularly for resident shorebirds such as plovers, sandpipers and avocets (see Appendix, Chapter K).

e. Impact 5

The fifth impact would be a change in the micro-climate caused by the increased available moisture. Even though it is already irrigated, humidity is not all that great during summer.

Discussion: A change in the plant and animal species will result with the maintenance of high humidities, especially over pasture and marsh areas. The increased humidity may affect species growing on land side of the levees. This could promote the growth of more vegetation or accelerate the growth of present vegetation. The effect on area wildlife would be problematical. This would occur if wastewater was applied in quantities greater than those that are presently used for irrigation. Irrigation is often done by regulation of the depth of the water table.

Remedial, Protective and Mitigation Measures: The impact cannot be mitigated except by the reduction in volume of incoming water.

f. Impact 6

The sixth impact would be a reduction in the water quality of recovered water from surface, subsurface and groundwaters.

Discussion: The estimated recovery water contains several components which could degrade the water quality of Site 43: total nitrogen (TN), total phosphorous (TP), and total dissolved solids (TDS). The water quality values for these parameters are given in Table V-A-7. Existing water quality conditions with respect to TDS, TN, and TP have been presented in Table V-I-1.

The upper limits of the recovery water TDS exceeds the existing water quality condition known for Site 43. High TDS would encourage the growth of plant species which are salt tolerant. High TDS (over 1,000 mg/l) is suspected of reducing reproductive capacities insome fish species such as the Centrarchids and Cyprinids (sunfish and carp).

Total nitrogen levels higher than 1 mg/l and phosphorous levels above 0.1 mg/l generally encourage noticeable growths of algae. Waters which are rich in nitrogen and phosphorous can have algae "blooms" of such magnitude that fish and other aquatic animals may be killed by associated sags in available oxygen (oxygen used by the living and decomposing algae).

The waters collected in drainage ditches and canals (surface and subsurface) may have TDS values in excess of those values which affect fish reproduction. TP and TN values are judged to exceed those values that encourage algal growth. They generally exceed those limits recommended by the State as suitable for discharge to the Delta.

Drainage waters which are pumped out of fields into the Delta rivers, canals and sloughs will be diluted. The introduced waters will add to the total TDS, TN and TP load already carried by these waters, as well as adding an additional organic load contributed by the agricultural lands and the original wastewater organic load. If flows of the Delta waters are sufficiently high, the added load should not be significant. Pumping of recovered wastewater into dead-end sloughs may significantly reduce their water quality, because these areas naturally flush slowly and have lowered levels of dissolved oxygen.

Remedial, Protective and Mitigation Measures: Recovery canals should not be expected to have a sustaining fishery in areas of high TDS. Pump-out locations should be limited to those areas with adequate mixing and dilution flows (as opposed to restricted channels and dead-end sloughs).

Monitoring of all outflows will be necessary to control the water quality of the effluent. High TDS, TN and TP waters may require pre- or post-application

treatment to prevent degradation of surface or groundwaters.

g. Impact 7

The seventh impact would produce a change in wildlife, fish, and vegetation on or near channel islands, channel marshes, levees, berms, etc., of Fabian and Bell Canal, Grant Line Canal, Victoria and North Canal, San Joaquin River, Middle River, Old River, Trapper Slough, Whiskey Slough, Salmon Slough and Turner Cut.

Discussion: The most important wildlife habitats within the project area occur in the riparian growth on channel islands, channel marshes, levees, berms, etc., along the watercourse. As discussed above, the areas most likely impacted by reduced water quality will be those areas in or near standing or slow moving water. The vegetation and wildlife of these areas will be impacted in relation to their direct or indirect reaction to increased TDS, TN, TP or other, as yet unidentified water quality parameters. This impact could be considered site specific to Site 43 since these sloughs and channels belong to the Sacramento-San Joaquin Rivers Delta which is rather unique region in the state.

Remedial, Protective and Mitigation Measures: Recovery waters should be discharged only into Delta waterways which have sufficient flow to dilute the wastewater

Recovery waters should be monitored in order to control the water quality of the effluent. Pre- or post-application treatment may be required to protect the water quality of the Delta waterways.

h. Impact 8

The eight impact is TDS buildup in soils that receive treated wastewater.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 7 for Site 5 (Section C-6g).

i. Impact 9

The ninth impact would be the loss of recreation opportunities and potential due to a reduction in the water quality and in the quality and

quantity of vegetation, fish and wildlife of the Delta waterways within the influence of the project area.

Discussion: Any reduction in water quality that would impact fish, wildlife, and vegetation (high TDS, low DO, nuisance algal blooms) in the Delta would reduce the receratational potential of the Site. The gross recreational potential available to the Study Site was determined to be 265.68 million visitor-days per year. Many of these visitors utilize the excellent hunting, fishing, and boating opportunities found in this Delta area.

Remedial, Protective and Mitigation Measures: Monitor watercourses that are receiving recovered wastewater to control and keep the water quality within the public health water contact specifications.

Control wastewater quality pre- and post-application to insure acceptable water quality of waters discharged into recreation waterways.

j. Impact 10

The tenth impact would be the introduction or encouragement of wildlife and fish diseases from wastewater applications.

Discussion: Avian cholera (wildlife disease discussion - Area 43) can be spread by pathogenic bacteria which remain viable in standing water for at least three weeks. Wastewater will not be a source of the disease but it should be managed in a way to minimize the disease.

Remedial, Protective and Mitigation Measures: Manage all wastewater application to diminish or prevent disease occurrence.

Monitor wastewater pre- and post-application to prevent the introduction of disease organisms.

In the case of avian cholera, waters should not remain standing. Winter flushing waters should be drained and discharged. Marsh areas would have to be drained if an epidemic of avian cholera occurred.

k. Impact 11

The eleventh impact would be the generation of unpleasant odors.

Discussion, and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 21 for Site 5 (Section C-6u).

l. Impact 12

The twelfth impact would be increased mosquito and midge populations.

Discussion and Remedial, Protective and Mitigation Measures: Refer to the discussion of Impact 16 for Site 5 (Section C-6p).

m. Summary of Sensitive Areas

Figure V-B-2 delineates the location of environmentally "sensitive" areas in Site 43. "Sensitive" areas are those which have serious impact potential under the proposed project in terms primarily of fish, wildlife, vegetation, and/or recreation. Areas of prime importance would generally be waterways, existing and proposed recreational facilities and areas, prime wildlife habitat, the actual locale of rare or endangered species, unique vegetation, notable scenic locations and vista points, etc. Urban, industrial, and agricultural lands are usually not considered highly "sensitive" areas.

The "sensitive" areas of Site 43 consist of: (1) the San Joaquin River along the northern and eastern perimeter of Roberts Island (Sub-Site 43.2,) the riparian and marsh vegetation areas along each bank, and recreational areas which run along each bank for portions of the river, (note, poor water quality conditions exist along all of the northern perimeter and the northern half of the eastern perimeter reach,) (2) Old River, Middle River, Fabian and Bell Canal, Grantline Canal, North Canal, Victoria Canal, Trapper Slough, Whiskey Slough, and Turner Cut which provide the remaining perimeter for Sub-Sites 43.1 and 43.2, Roberts and Union Islands, together with the riparian and marsh vegetation and recreational areas which run along all of their banks, and (3) a channel running north-south through the center of Union Island between Middle River and Fabian and Bell Canals.

SECTION J

J. SUMMARY OF ENVIRONMENTAL AND ECOLOGICAL IMPACTS OF PROPOSED WASTEWATER LAND APPLICATIONS

1 - Summary of Long-term and Short-term Impacts

The environmental impacts brought about by the land application of treated wastewaters can be classified as short or long term. Short-term impacts refer to those temporary effects which are felt during the construction phase or which may persist for 10 years following construction or installation of project features. Long-term impacts are those which persist indefinitely or for a long time after project implementation and may be generated sometime after commencement of project operation. Both short-term and long-term impacts can be primary or secondary in nature; primary if the impact stems directly from the existence, construction, or operation of physical features of the project, and secondary when the impact results as a second-level effect of the project functions. For example, a change in the microclimate due to aerial spraying would be a primary long-term impact. The additional moisture would change the composition of vegetation in the area. A secondary impact would be the effect on wildlife resulting from the change in vegetation.

a. Long-Term Impacts

Significant beneficial and adverse long-term impacts have been discussed in chapters B through I for study sites 4, 5, 18, 21, 27, 28, 42, and 43, together with a brief analysis of remedial, preventitive, and mitigation measures concerning the adverse impacts. A concise summary of this is compiled and presented in Table V-J-1.

b. Short-Term Impacts

Impact I

Disruption of normal activities and life cycles of native flora and fauna during the construction of pipelines, pump stations, distribution lines, treatment facilities, and impoundments and associated structures (dams, fills, maintenance buildings, etc.) constitutes the first significant short-term impact.

Table V-J-1

SUMMARY TABLE OF ENVIRONMENTAL IMPACTS ON
SAN FRANCISCO BAY - DELTA WASTEWATER LAND APPLICATION STUDY SITES

Number	IMPACTS	WASTEWATER MANAGEMENT AREAS																REMARKS
		4		5		18		21		27		28		42		43		
		1/ Eff	2/ Deg	Eff	Deg	Eff	Deg	Eff	Deg	Eff	Deg	Eff	Deg	Eff	Deg	Eff	Deg	
	Vegetation, Habitats, and Ecosystems																	
1	Change in the species association because of the change in land use produced by the introduction of additional moisture.			X	S	X	S	X	S	X	S	X	S	X	S	X	S	Unavoidable problematical impact.
2	The change in species composition in the Suisun Marsh due to wastewater application.	X	S															Unavoidable impact, may be adverse or beneficial depending upon how wastewater is added.
3	Change in streambank vegetation.			X	I													Unavoidable impact, may increase or decrease productivity of riparian vegetation.
4	Destruction of wildlife habitat and edge cover along existing canal systems.															-	I	Unavoidable adverse impact that will be irretrievable commitment of the resource.
5	Loss of wildlife species through loss of habitat (lands, vegetation) to project facilities.	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	Unavoidable adverse impact. Irretrievable commitment of the resource and loss of productivity.
6	Expansion of marshlands.			+	I					+	I							Beneficial increase in long term productivity in this instance.
7	The possible loss of land being managed for dry land grain production.	-	I															Unavoidable adverse impact if wastewater is applied to this land.
8	Loss of wild land habitat permanently committed to pumping statins, impoundment sites and facilities, maintenance roads, and above-surface distribution systems.	X	I	X	I	X	I	X	I	X	I	X	I	X	I	X	I	Unavoidable adverse impact, although impact could be mitigated if native vegetation is planted around facilities. This may attract some wildlife species.
9	Change in the micro-climate caused by the increased available moisture.			X	S	X	S	X	S	X	S	X	S	X	S	X	S	Unavoidable impact, which may affect productivity adversely or beneficially depending on the existing microclimate.
10	Loss of vegetation, wildlife habitat, and wildlife on spoil areas.	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	Adverse impact unless spoils areas are revegetated with native plant species.
11	TDS buildup in soils that receive treated wastewater.			-	S	-	S	-	S	-	S	-	S	-	S	-	S	Unavoidable adverse impact that could reduce long term productivity.
12	Increase in gamebird habitat (and populations).			+	I					+	I	+	I	+	I			Beneficial increase in productivity.
13	The effect of wastewater storage reservoirs on the fish and wildlife, vegetation, and recreational potential of Area 21.							X	U									Permanent commitment of the land to a reservoir; may be beneficial depending upon water quality.
14	Change in wildlife, fish, and vegetation on or near channel islands, channel marshes, levees, berms, etc., of Fabian and Bell Canal, Grant Line Canal, Victoria and North Canal, San Joaquin River, Middle River, Old River, Trapper Slough,															X	U	Unavoidable adverse impact, and a reduction in long term productivity if

	spoil areas.									revegetated with native plant species.
11	TDS buildup in soils that receive treated wastewater.		- S	- S	- S	- S	- S	- S	- S	Unavoidable adverse impact that could reduce long term productivity.
12	Increase in gamebird habitat (and populations).		+ I			+ I	+ I	+ I		Beneficial increase in productivity.
13	The effect of wastewater storage reservoirs on the fish and wildlife, vegetation, and recreational potential of Area 21.				X U					Permanent commitment of the land to a reservoir, may be beneficial depending upon water quality.
14	Change in wildlife, fish, and vegetation on or near channel islands, channel marshes, levees, berms, etc., of Fabian and Bell Canal, Grant Line Canal, Victoria and North Canal, San Joaquin River, Middle River, Old River, Trapper Slough, Salmon Slough and Turner Cut.								X U	Unavoidable adverse impact, and a reduction in long term productivity if water quality is poor.
	Wildlife									
15	The possible reduction of waterfowl populations	- S								Unavoidable adverse impact and a reduction of waterfowl habitat if wastewater is applied improperly.
16	Increase in waterfowl resting and hunting sites.							+ I		Beneficial impact.
17	Possible reduction in the number of birds taken by hunters.	- S								Unavoidable adverse impact on reactional use, if wastewater is applied improperly.
18	Increased crop depredation in Capay Valley.		- I							Unavoidable adverse impact, asscoiated with increasing deer herd size.
19	Increased deer road kills. (Capay Valley)		- I							Unavoidable adverse impact associated with increasing deer herd size or automobile traffic.
20	The effect of constant moisture or humidity on wildlife.			- U						May be a very significant adverse impact depending upon the effect of constant moisture on the individual species involved.
21	Introduction and encouragement of wildlife diseases from wastwater applications.	- S	- S	- S	- S	+ U	- S	- S	- S	Unavoidable adverse impact in specific areas. May decrease long term productivity.
22	Increased mosquito and midge population.		- I	- I	- I	- I	- I	- I	- I	Unavoidable adverse impact, especially where marsh conditions are produced.
	Fishery									
23	Enhancement of warmwater fisheries.		+ I			+ I				Beneficial impact, increase in long term productivity.
24	Enhancement of fishery potential in Marsh and Kellogg Creeks.							+ I		Beneficial impact locally, if water quality is high.
25	The establishment of permanent waterflows in heretofore intermittent streams (and fishery).			+ I	+ I					Beneficial impact if water quality allows the establishment of a fishery.
26	The possible disruption in the life cycle of anadromus salmonid fishes because of a change in the water quality due to the addition of treated wastewater.			- S	- S					Unavoidable adverse impact and loss of productivity if wastewater quality prevents adult salmon from ascending streams.
27	The possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.	- S	- S	- S	- S		- S	- S	- S	Potential adverse impact that would lead to loss of long term productivity of the resource.
28	The increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater.	- S	- S	- S	- S	- U	- S	- S	- S	Unavoidable adverse impact associated with creation additional habitat for intermediate hosts. This may affect long term productivity of the fishery.
29	The introduction of fish diseases and parasites into new areas by the application of treated wastewater.	- S	- S	- S	- S	- U	- S	- S	- S	Potential adverse impact, that could lead to loss of long term productivity of the resource.
30	The increase in fish diseases because of higher water	- S	- S	- S	- S		- S	- S	- S	As in impact 32

	due to the addition of treated wastewater.									adult salmon from ascending streams.
27	The possible degradation of the recreational fishery due to increased parasite and disease loads introduced by the application of treated wastewater.	- S	- S	- S	- S		- S	- S	- S	Potential adverse impact that would lead to loss of long term productivity of the resource.
28	The increase in the intermediate hosts (molluscs and copepods) of fish parasites by the application of treated wastewater	- S	- S	- S	- S	- U	- S	- S	- S	Unavoidable adverse impact associated with creation additional habitat for intermediate hosts. This may affect long term productivity of the fishery.
29	The introduction of fish diseases and parasites into new areas by the application of treated wastewater.	- S	- S	- S	- S	- U	- S	- S	- S	Potential adverse impact, that could lead to loss of long term productivity of the resource.
30	The increase in fish diseases because of higher water temperatures of recovered wastewater and increased bacterial growth.	- S	- S	- S	- S		- S	- S	- S	As in impact 32
31	An increase in stress factors of fish and their relationship to the susceptability of fish to disease and parasitism.	- S	- S	- S	- S		- S	- S	- S	As in impact 32.
	Water Quality									
32	Reduction in the water quality of recovered water from surface, subsurface and ground waters.	- S	- S		- S	- S	- S	- S	- S	Unavoidable adverse impact, irreversible and irretrievable commitment of resource and a loss of long term productivity.
33	Reduction of quality in groundwater stores used for domestic purposes.							- S		As Above.
34	Reduction of water quality in Sacramento-San Joaquin Delta.							- I		As in No.35. Portions of the Sacramento-San Joaquin Delta are presently in poor water quality areas.
35	Increased eutrophication of Sacramento River and connecting canals.		- I							Unavoidable impact that maybe adverse. Unwanted increase in long term primary productivity.
36	Reduction in the water quality of the lower Russian River because of high total dissolved solids (TDS).			- I						As in impact 35.
37	Possible accelerate eutrophication of the lower Russian River because of an increased biostimulant load.			- I						As in impact 38.
38	The accelerated eutrophication of small streams in Area 18 because of increased biostimulants from recovered wastwater.			- I						Probably an adverse impact although small amounts of biostimulants may beneficially increase long term productivity.
39	Probable accelerated eutrophication of surface waters in Area 21 by increased biostimulants (and increase in livestock on pasturage).				- I					As in impact 38.
40	Pollution of Nicasio Reservoir by surface and subsurface drainage of wastewater.		- I							Unavoidable adverse impact if wastewater is applied to the Nicasio Reservoir drainage. Possible contamination of a water supply.
41	Increased turbidity in streams and canals receiving wastewater (erosion).		- I	- I	S	- S	- S			Unavoidable adverse impact, may cause serious damage to the fishery and reduce long term productivity.
42	Prevention of salt intrusion into the marsh, especially during summer and fall months and "abnormally dry" years.	+ S								Beneficial impacts.
43	Improvement of Sacramento-San Joaquin Delta salt water intrusion problem.							+ I		Beneficial impact.
44	Possible increase in termperature of surface waters and a change in species compostion of the water.			- I	- I		- I			Unavoidable adverse impact if wastewater enters surface waters at a significantly higher temperature. May cause an undesirable change in species associated.
45	Possible changes in the ecology of Tomales Bay because of			- I						Avoidable adverse impact, if the Tomales Bay

44	Possible increase in termperature of surface waters and a change in species compostion of the water.			- I	- I		- I			Unavoidable adverse impact if wastewater enters surface waters at a significantly higher temperature. May cause an undesirable change in species associated.
45	Possible changes in the ecology of Tomales Bay because of the addition of wastewater by surface and subsurface drainage.			- I						Avoidable adverse impact, if the Tomales Bay drainage is removed as a wastewater disposal area.
46	Augmentation of summer stream flows.			+ I		- I	+ I			Beneficial impact, if the wastewater quality is high.
47	Possible increase in heavy metals and miscellaneous organic poisons which may be toxic to fish and wildlife.	- I		- I	- I					Potential adverse impact if the heavy metals in the wastewater are not removed to trace amounts before application.
48	Possible increase in eutrophication of Monterey Bay					X U				Potential adverse impact. The degree is presently undeterminable.
49	Eutrophication of the Salinas River and its tributaries by increased runoff from pastureland and feed lots.					- S				Adverse impact, may affect water quality and downstream fisheries (from Study Site).
	Recreational, Scenic and Educational Values									
50	Loss of recreation opportunities and potential due to a reduction in the water quality and the quality and quantity of vegetation, fish and wildlife in reservoirs, farm ponds and streams.			- S			- S	- S	- S	Unavoidable adverse impact, irreversible and unretrievable commitment of a resource and a loss of long term productivity.
51	Change in scenic recreational value of the area (plus roadside areas).		- S		- S	- S	- S	- S		As in impact 51.
52	Loss in educational value of Capay Valley.		- I							As in impact 51.
53	Loss of present and potential recreation and riparian vegetation along major stream channels.					- I		- I		Potential adverse impact and a reduction in productivity.
54	Personal contact of wastewater with persons using facilities on Area 4.	- I								Unavoidable adverse impact. May cause a reduction in recreational potential and health hazard.
55	Generation of unpleasant ordors.		- I	- I	- I	- I	- I	- I	- I	Unavoidable adverse impact. May reduce recreational potential.
56	Potential increase in stream bank recreational opportunity					+ I				Beneficial impact

Notes:

1/ Effect of the impact

- Adverse

+ Beneficial

x Problematical - i.e., negative or positive effects not determined; requires additional assessment

2/ Degree of the impact

Discussion: Construction activities and the associated noise and dust produced could interfere with the life cycle of on-site flora and fauna. Detailed on-site study with an engineering design plan would be necessary to locate specific areas where construction activities would disrupt normal activities of native flora and fauna. In general, construction activities may temporarily disrupt such activities as seasonal or daily movements of wildlife (ie., deer) disruption in reproductive activity of wildlife, siltation of streams, reduction in vegetation on areas cleared by construction activities, and possible damage to vegetation adjacent to construction zones because of increased dust.

Remedial, Protective and Mitigation Measures: Preplan and limit construction and facility rights-of-way to the smallest area compatible with efficient operation. Constraints on construction for the purpose of protecting the environment should be detailed in the job specifications and be made a part of the construction contract. The use of the Corps of Engineers draft Environment Protection contract specifications would be one long step in this direction. The confining of pipelines and other distribution lines within existing roadway rights-of-way would be another way to minimize areal effects of construction on native vegetation.

Install water collection and drainage systems that minimize erosion.

Require reseeding and/or other method of revegetation of all temporary and permanent earthen rights-of-way.

Require "watering down" of all construction sites where aerial dust is created.

Require sound baffles and/or muffled equipment to reduce noise levels when these levels are greater than 50 decibels.

Require all fuels and maintenance fluids for construction equipment be properly containerized and all surplus and waste products removed from the construction site and properly disposed of.

Require that corporation yards be fenced, of the smallest practical size, and placed on sites least destructive to the native vegetation and natural habitats.

Stake out and protectively mark trees and shrubs along, but not directly in the construction path.

Construct pipelines by the single operation method (ditching, laying pipe, and covering over all in one continuous operation). Leave no open

trenches that may entrap, injure, or kill local fauna or present a safety hazard to people.

Provide adequate and convenient sanitary and litter collection facilities for construction personnel.

Dump no construction materials, chemicals, soils, etc., into stream or river channels.

Confine pipelines and other distribution or collection conduits along routing which will be the least destructive to the natural environment, eg., routing within existing roadway rights-of-way.

Restore all temporary roads, corporation areas, rights-of-way and turnouts to their original condition - returned to same contour or at least blended into the adjacent landform - seeded, fertilized, and planted to localized native vegetation.

Stockpile topsoil for future use in revegetation.

Impact 2

Loss of wildlife habitats and native vegetation on temporary construction roads, rights-of-way, turnouts and corporation areas constitutes a second significant short-term impact.

Discussion: The construction of these temporary work areas destroys the native vegetation, compacts the soil and removes the fertile topsoils. This retards regrowth and revegetation. Wildlife and wildlife habitats will also be lost on these areas. The magnitude of this impact is problematical at this stage of project evaluation. More detail engineering design will produce the information necessary for more precise evaluation of this impact.

Remedial, Protective and Mitigation Measures: See discussion concerning Impact 1.

Impact 3

Unsightly and/or destructive spoils areas covering native vegetation and wildlife habitat is a third possible significant short-term impact.

Discussion: The deposition of construction spoil destroys the underlying vegetation and wildlife habitat. The spoil "pile" in itself can be aesthetically undesirable, particularly if the spoil soil is of poor quality and natural revegetation is slow. Poorly placed and constructed spoil areas can be the source of sediment and the beginning points of extensive erosion. The magnitude of habitat destruction by spoils cannot be accurately determined until the detail design phase of project development. Spoil areas could be extensive considering the size of several application sites (ie., 5 and 18) and would depend primarily on the degree to which excavation predominates over fill or backfilling. Pipelines would generally utilize all excavated materials in the backfilling operation.

Remedial, Protective and Mitigation Measures: The location of a spoil area is critical. A site will be chosen that covers the least amount of vegetation, particularly the vegetation used by animal species for food and cover. The construction and location of the spoil should not increase local erosion or contribute to erosion in itself.

Spoil areas should be hydromulched as soon as deposition has been completed. Localized native shrubs and trees will be planted on the spoil area. If particularly important habitat (food, cover) is lost by covering with spoil, the spoil area should be planted with the same or similar species.

Spoil areas will be constructed to blend with the local topography and be seeded and planted with localized native plants to blend with the native plants.

Plant species chosen for revegetation will be among those native species which will flourish in the area and provide food and cover for wildlife.

Spoil areas should be placed far enough away from streambeds and with sufficient intervening vegetation to protect the stream from sediment caused by any erosion of the spoil area.

Fertilization and treatment of the spoil may be needed if it is poor quality subsurface soil.

Impact 4

Dust, created by construction work, blanketing adjacent vegetation and killing or injuring the plants is another possible significant short-term

impact. Dust can reduce habitat (food, cover) for wildlife species. Visible layers of dust also have adverse aesthetic effects.

Discussion: Layers of dust on leaves reduce the gas exchange and the photosynthesis process in plants. The plants' survival potential is reduced as well as the food value and palatability to wildlife species. The amount of dust generated by construction activities will depend upon the specific area, soil types, the nature of the construction, local weather conditions, and the degree to which mitigative measures are followed (ie., watering roads.) If mitigative measures are followed and construction does not occur on exceptionally windy days, dust will probably be kept to a minimum and restricted to areas immediately adjacent to the construction site.

Remedial, Protective and Mitigation Measures: All construction sites, roads and corporation areas where dust is created should be watered down as often as necessary to keep aerial dust to a minimum.

Impact 5

Destruction or displacement of wildlife by construction work and equipment, and by increased traffic is another possible significant short-term impact.

Discussion: Increased traffic on present roads and temporary construction roads will increase the number of road killed animals. Construction activities - human activity, heavy construction movements (subsurface vibrations,) noise, etc. - will disturb resident animals causing them to move out of the construction area. If the adjacent area into which the animals move is already at its carrying capacity for that species, the population of the species will be reduced. For each species displaced, the adjacent population of that species will be affected.

The extent to which this will happen depends upon the amount of construction and the acreage affected. This impact is expected, however, to be a minor one and only of temporary concern.

Remedial, Protective and Mitigation Measures: Construction crews and other project-related personnel should be made aware of road-kill hazards.

Roads and construction areas should be posted with warning signs for animal crossings.

Noise and construction activities should be kept to a minimum needed to perform the work.

Temporary roads, turnouts and corporation areas should be located in areas of low wildlife density. Temporary fencing or barriers should be placed at heavily used wildlife crossings.

Impact 6

Loss of recreational opportunities by local and out-of-area hunters and fishermen is another possible significant short-term impact.

Discussion: The construction activities could disrupt the game populations, causing reduced reproduction and/or migration out of the area. The hunters in the project area would have reduced hunting success due to the reduction in numbers of game species.

Hunting opportunities would also be reduced on the project area because hunting would be imcompatible with construction due to the possible danger to the construction workers.

For example, construction activities on Site 4 (Grizzly Island-Suisun Marsh) during the months of October through January may reduce waterfowl hunting opportunities. Construction activities would disperse large flocks of migratory waterfowl onto other areas which may have poorer quality food or reduced hunting access.

Fishing success could be reduced by the silting of the stream which would reduce the number of young fish. Construction activities on Sites 18, 21, and 28 could lead to increased erosion and siltation in the small coastal or inland streams such as Pescadero, Gazos, Walker, and Maacama Creeks, which are important spawning areas for salmonid fish. Siltation of the streams when eggs or alevins (young salmon) are present in the stream (winter) may seriously damage present and potential fish stocks.

Remedial, Protective and Mitigation Measures: The temporary loss of hunting and fishing would be partially mitigated by the measures described under Impacts 1, 4 and 5. The loss of hunting opportunities near construction sites would not be mitigated.

Impact 7

Pipeline scars clearly visible on landscape can be another significant short-term impact.

Discussion: After disturbance, some soils may not be of a consistency and fertility that permits voluntary revegetation for several years. Scars across such areas are visible and, depending on the location, can have a serious adverse impact on the aesthetic value of the area. Such scars often contribute to erosion or invite vehicular traffic of an unplanned nature.

Remedial, Protective and Mitigation Measures: Stockpile top soil from pipeline routing during construction and reapply.

Provide an adequate base for the pipe in order for the ground to return to its pre-existing topography.

Fertilize, cultivate and promote the revegetation of the pipeline routing with acceptable species.

2 - Identification and Analysis of Adverse Environmental Effects Which Cannot be Avoided with Project Implementation

a. General Adverse Impacts

The seven proposed wastewater disposal areas have many vegetation and wildlife associations in common. For this reason, a discussion of general adverse and unavoidable impacts applicable to all areas should precede a discussion of impacts unique to specific areas.

The most important unavoidable adverse ecological impacts of the land application of treated wastewater will be the loss of the flora and fauna associated with the existing land uses. The addition of treated wastewater in excess of waters which an area now receives will change its associated flora and fauna. Where cropland is converted to pastureland and marsh, the present ecosystem will be replaced by wet meadow or marsh associated plants and animals. Animal species that would be affected by a change in ecosystems can be ascertained from the species list (in the Appendix, Chapter K) by examining the habitat and food habits column of these tables. Because detail design information is not part of this study, predictions on new habitat types are correspondingly limited. The pre-application ecosystem and its associated plants and animals will be lost, although at the level of analysis of this study it would be impractical to define every ecosystem that will be affected by wastewater land applications. Specific information concerning these matters should be obtained and evaluated during the detailed design phase of any project development for specific sites.

A second important adverse effect of the project will be the loss of vegetation/habitat and, in some cases, wildlife from the lands which will be occupied by project facilities - pipelines, pumping facilities, distribution lines, impoundment areas and associated structures, etc.

Because the water being applied to the land will generally be secondary-level treated wastewater, and because its estimated quality in terms of TDS is higher than the existing TDS values of surface waters, there will be an unavoidable increase in the salinity of many existing waters receiving the land application runoff and percolate, but only to the extent that management of land application systems allow such runoff and/or percolation or cannot prevent it given the circumstances of system operations. TDS levels above 1000 mg/l may reduce reproductive capacities in Centrarchid and Cyprinid fish. Any future technological breakthroughs concerning demineralization may make pre- or post-treatment for TDS reduction a feasible mitigative measure relative to this adverse impact problem.

The TDS increase will be accompanied by increases in total nitrogen and phosphorous. These latter two plant nutrient elements stimulate algae blooms and accelerated eutrophication of water bodies. Total nitrogen levels above 1.0 mg/l and total phosphorous levels above 0.1 mg/l will generally encourage noticeable algal "blooms." Increases in total nitrogen and total phosphorous may be adverse or beneficial, depending upon the amounts present in the body of water prior to application and the amounts present in the recovered wastewater. Proper monitoring and control of water quality could reduce the effects of TDS, total nitrogen and total phosphorous on fish, wildlife and vegetation. Current estimates of TN and TP in recoverable wastewaters would be significantly reduced if TN and TP inputs into the wastewater system were reduced or were otherwised prevented from increasing as initially estimated. Pre- or post-treatment for TN and/or TP could be employed if necessary, but it would add to the cost of system operations.

The human psychological distaste of coming into direct contact with wastewater may effectively remove all application zones from recreational use. Although this psychological displeasure will not occur in all humans, it is nevertheless an unavoidable adverse effect of wastewater application.

b. Specific Adverse Impacts

Site 4: Because the entire area is used for public and private recreation, it will be impossible to avoid human contact with treated wastewater. The deleterious psychological effect of this contact will reduce the area's recreational value for those averse to wastewater contact.

Site 5, 42, and 43: Wastewaters applied to Sites 5, 42, and 43 will eventually reach the Sacramento-San Joaquin River and Delta System. Whether the drainage is surface, subsurface, immediate or delayed, there will be an unavoidable increase in TDS in the receiving waters in some locations. Wastewater, recovered from Site 5, draining into the Sacramento River near Knights' Landing is estimated to be higher in TDS than the TDS level presently found in the Sacramento River at this location. The degree and the effect of possible increases in TDS in the Delta area by water recovered from these wastewater disposal sites is problematical. The main stem of the San Joaquin River near Stockton (Site 43) is an area of poor water quality because of the present Delta water flow regimes.

Site 18: Wastewaters applied to the southern half of Site 18 (south of Estero de San Antonio) will eventually flow into Tomales Bay. Additions of primarily nitrogen to this enclosed bay will result in accelerated marine algal blooms (such as Nostocaceae, Oscillatoriaceae) and a potential for reduced dissolved oxygen content. Poor flushing action makes Tomales Bay especially susceptible to these eutrophication problems. Accelerated eutrophication may greatly alter the present ecosystem of Tomales Bay, be a detriment to estuarine fish populations (lowered dissolved oxygen levels) and adversely affect local commercial oyster beds present in the Bay.

Site 21: The Russian River will eventually receive runoff from application of wastewater on any section of Site 21. The quality of the recovered wastewater is expected to exceed the TDS, TN and TP objectives of the Interim Water Quality Control Plan of the California Regional Water Quality Control Board for the North Coast Region and exceed water quality levels presently found in the lower and middle Russian River. TDS (over 1000 mg/l) would be deleterious to some warmwater fish present in the river. Nitrogen and phosphorous levels that produce algal "blooms" have the potential to diminish fish stocks by lowering the DO. Adverse impacts on the aquatic environment of the Russian River would reduce the recreational potential of the area. Aquatic recreation is now adversely affected by eutrophication of the lower Russian River.

Site 27: The quality of recoverable wastewaters is expected to exceed the TDS and nitrate objectives for surface and ground waters in the Salinas basin.

3 - Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enchancement of Long-Term Productivity of the Environment - Ecological

The present practice of discharging treated wastewater into Sacramento and San Joaquin Rivers and Delta, San Francisco Bay and the Pacific Ocean represents a short-term consumption of a limited resource -- fresh water. The land application of treated wastewater represents a reuse and recycling of this resource. The use of wastewater will increase biological productivity, both agrarian and for fish, wildlife and native vegetation. The reuse of water, therefore, will provide an increase in long-term productivity.

The present biological communities on the lands which will be covered with project facilities will generally be lost or greatly altered by the project. The capacity to support existing vegetation and wildlife will be lost where project facilities are located. Underground facilities will reduce surface vegetation if they require access roads, for maintenance and repair, that must be kept clear of vegetation. Land without vegetation does not support wildlife to any great extent.

The overall biological productivity of lands under wastewater application will depend on the water application and management schemes used at a particular location. Primary production produces different values for different environments. The various environments within the project areas can be grouped into three major classes. These classes are arranged in order of increasing primary productivity with dry grassland and dry farming the least productive while estuarine and moist evergreen forests are some of the most productive.

Grouping	Environments
Class I	Grasslands (dry) (Site 5) Some agriculture (dry)
Class II	Mountain forests (Site 18) Shallow lakes and ponds Moist grasslands Moist agriculture (Site 43)
Class III	Some estuaries (Site 4) Semi-aquatic and terrestrial communities on alluvial plains Intensive (year-round) agriculture Evergreen forests (moist)

(After Ref. 3)

The primary productivity of an area with the addition of treated wastewater may increase or decrease depending on the present environment of the area and the environment resulting from the application of treated wastewater. In the case of dry grassland and dry farmed areas, the primary productivity could be greatly increased by the addition of water. An increase in production would occur, if the resulting plant and animal communities were agricultural or natural.

In areas in which the present environment would not be drastically changed by the addition of treated wastewater, as in using wastewater in existing agricultural areas for irrigation, the productivity may increase due to the addition of biostimulants such as nitrogen and phosphorous. The change in primary biological production in any portion of a study area may be estimated by noting whether the new environment created by wastewater application is in a different productivity grouping than the pre-existing environment. It should be noted in using the productivity grouping that these classifications represent only approximations and that each type of environment and each specific locale would have their own specific productivity level.

The application of treated wastewater will increase the productivity in most areas where dry grassland or brush will be converted to wet pasture, forest or marsh. In areas in which the vegetative cover does not change, the changes in productivity will depend on the quality of the applied water. Improved productivity does not mean, however, more desirable ecosystems. Levels of productivity and the desirability of new communities will have to be determined by pilot studies during the detail design stage of Site's development.

4 - Irreversible and Irretrievable Commitments of Resources

a. General

The seven proposed wastewater disposal sites have many fish, wildlife, vegetation and recreation resources in common. Because this report does not deal with specified facilities in specified locations, general vegetative types, wildlife associations and recreational uses have been discussed. Most of these general vegetative, wildlife and recreational categories are common to all areas and can be analyzed as a group. The following resource commitments are common to all areas.

Construction of ponds, reservoirs, roadways, canals and maintenance facilities will permanently remove vegetation and wildlife habitat and any associated recreation. Degradation of water quality in inland waterways will reduce the fisheries resource; streams having anadromous fish runs deserve special consideration as their statewide extent is already limited. Application of wastewater over large areas of grassland will alter both the flora and fauna, creating permanent pasture or cropland and possibly displacing burrowing rodents, mammals and birds. The level of water quality will determine the increase or decrease in lake, reservoir, canal and stream value as a recreational resource. Degradation of existing water bodies may permanently omit water contact sports, reduce the recreational fishing potential, and make the general area undesirable as a hiking, picnicking, boating or camping site. Increase in streamflows through application of wastewater will alter bankside vegetation along presently intermittent streams. The cover permanently lost may be replaced by a more productive type, depending upon the management system developed in the area.

Continued application of wastewater on any natural vegetative cover type, whether it be dry grassland or virgin redwood forest, will essentially alter and remove some plant associations and the wildlife dependent on them. The resource will be lost for an indefinite period of time. If application ceases, the vegetation and wildlife may slowly revert to a prior status or it may assume a completely different character. Whether or not the new species associations are more desirable or beneficial environmentally is problematical. Until the design plan for a Site's development becomes available, more precise information on the irreversibility and irretrievability of the commitment of resources would be somewhat speculative.

b. Specific Resource Commitments

Several resource commitments specific to one or two wastewater application areas deserve special mention. The two coastal Sites, 18 and 28, contain

estuarine salt water habitats that might be permanently altered by wastewater application. Lagoons and marshes existing at the mouths of freshwater streams would be altered by increased freshwater flows. Halophytic plant communities and salt water invertebrates, especially those present in the intertidal zone, may be permanently lost in favor of aquatic species. Tomales Bay, in Area 18, also deserves special attention. Because this natural bay is subject to a limited flushing action, increased eutrophication through addition of nitrogen and phosphorous compounds may permanently alter its present recreational potential and reduce its value as a waterfowl resting area.

Sites 18, 21 and 28 have small coastal or inland streams that support salmon and steelhead trout runs. Any degradation of water quality (particularly temperature or TDS) through wastewater applications in these Sites would diminish these salmonid populations.

Improper management of wastewater applications to Site 4 (Grizzly Island) could seriously upset the present brackish water plant community found there and replace it with a more freshwater plant community. This could reduce the present prime waterfowl habitat to one of secondary value for waterfowl.

Capay Valley and the surrounding hills is an area of distinctive geological, geographic, and botanical resources. The area serves as an outdoor classroom for many colleges and universities located in the Sacramento and San Francisco Bay regions. The application of wastewater in this area may alter the streamside terracing, geology, and vegetative species composition that is apparent in this area, rendering it unsuitable for prime outdoor classroom study purposes.

SECTION K

K. APPENDIX

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites

Common Name	Scientific Name	Habitat	Food Habits
Pacific lamprey	Entrosphenus tridentata	Adult - ocean young - coastal streams	Adult - parasitize, other fish
* River lamprey	Lampetra ayresii	Adult - ocean young - coastal streams	Adult - parasitize, other fish
* Western Brook lamprey	Lampetra richardsoni	Streams, not anadromous	Non parasitic, adult - do not feed young - detritis
Green sturgeon	Acipenser medirostris	Ocean, estuaries and large rivers	Bottom feeder, taking small fish, crustaceans, worms, and other invertebrates
White sturgeon	Acipenser transmontanus	Ocean, estuaries and large rivers	Bottom feeder, taking small fish, crustaceans, worms and other invertebrates
American shad	Alosa sapidissima	Adult - anadromous young - fresh water streams	Zooplankton
Threadfin shad	Dorosoma petenense	Reservoirs and large rivers	Zooplankton
Pacific herring	Clupea herengus (pallasi)	Inshore and bay spawning areas	Small zooplankton
Slough anchovy	Anchoa delicatissima	Inshore and bay areas	Small zooplankton

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Northern anchovy	*Engraulis mordax (nanus)*	Inshore and bay areas	Small Zoo-plankton
Rainbow trout	*Salmo gairdneri*	Cold water lakes and streams	Fish and invertebrates
Steelhead rainbow trout	*Salmo gairdneri (gairdneri)*	Adults - ocean young - small tributaries of coastal streams	Adult - fish young - insects, fish
Brown trout	*Salmo trutta*	Cold water lakes and stream	Primarily fish and insects
Chinook salmon (also King salmon)	*Oncorhynchus tshawytscha*	Adults - ocean young - small tributaries of coastal streams	Adult - fish young - insects, fish
Coho salmon (also Silver salmon)	*Oncorhynchus kisutch*	Adult - ocean young - small tributaries of coastal streams	Adult - fish young - insects, fish
Pink Salmon	*Oncorhynchus gorbuscha*	Adults - ocean young - small tributaries of coastal streams	Adults - fish young-insects, fish
Chum salmon	*Oncorhynchus keta*	Adults - ocean young - small tributaries of coastal streams	Adults - fish young - insects, fish
Whitebait smelt	*Ollosmerus elongatus*	No data	No data
Pond smelt	*Hypomesus olidus*	Bays and estuaries	Probably small crustaceans and worms

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Surf smelt	Hypomesus pretiosus	Bays and estuaries	Small crustaceans and worms
Longfin (Sacramento) smelt	Spirinchus thaleichthys	Bays and estuaries	Probably small crustaceans and worms
Tench	Tinca tinca	Quiet rivers, small ponds and lakes	Detritus and small aquatic organisms
Goldfish	Carassius auratus	Warm, turbid waters	Omnivorous
Carp	Cyprinus carpio	Warm, turbid waters	Omnivorous
Sacramento western roach	Hesperoleucus symmetricus (symmetrieus)	Warm, slow moving streams and rivers	Insects, algae, crustaceans
Monterey western roach	Hesperoleucus symmetricus (subditis)	Warm, slow moving streams and rivers	Insects, algae, crustaceans
Venus roach	Hesperoleucus venustrus	No data	No data
‡ Thicktail chub	Gila crassicauda	Quiet backwater	Plankton and small insect larvae
Fathead minnow	Pimephales promelas	Ponds, and backwaters of large rivers	Microscopic zooplankton and phytoplankton and insects

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Sacramento hitch	*Lavinia exilicauda (exilicauda)*	Lowland streams sloughs and lakes	Adults - pelagic plankton, young - zooplankton and insects
Monterey hitch	*Lavinia exilicauda (harengus)*	No data	No data
Splittail	*Pogonichthys macrolepidotus*	Large rivers, brackish water	Insects, plankton
Golden shiner	*Notemigonus crysoleucas*	Warm, turbid waters	Insects
Sacramento squaw-fish	*Ptychocheilus grandis*	Moderately clear rivers and streams	Insects, fish
Hardhead	*Mylopharodon conocephalus*	Clear, foothill streams	Omnivorous
Pacific speckled dace	*Rhinichthys osculus (carringtonii)*	Riffle area, small streams and shore areas of lakes	Detritus, small insects
Sacramento black-fish	*Orthodon micro-lepidotus*	Large natural lakes, sloughs, marshy overflow areas	Plankton, bottom organisms
Sacramento tui chub	*Siphateles bi-color (formosus)*	Lakes and quiet waters of larger streams	Adult - plankton, insects; young - small zooplankton
Sacramento western sucker	*Catostomus occidentalis (occidentalis)*	Spawn in stream mature in larger rivers	Omnivorous

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Monterey sucker	*Catostomus mniotiltus*	No data	No data
Brown bullhead	*Ictalurus nebulosus*	Sluggish rivers	Omnivorous
Black bullhead	*Ictalurus melas*	Sluggish rivers and lakes	Omnivorous
Channel catfish	*Ictalurus punctatus*	Large rivers with clear bottoms	Omnivorous
White catfish	*Ictalurus catus*	Swift flowing waters over clear bottoms	Omnivorous
Mosquito fish	*Gambusia affinis*	Ponds, irrigation canals, warm water	Insects
West coast three-spine stickleback	*Gasterosteus aculeatus (microcephalus)*	Ponds and fast flowing water	Insects, crustaceans, algae
Striped bass	*Morone saxatilis*	Adult - ocean young - coastal rivers	Adult - fish young - invertebrates
Sacramento perch	*Archoplites interruptus*	Lakes, sloughs and slow moving channels	Adults - fish young - insects, zooplankton
Warmouth	*Chaenobryttus gulosus*	Muddy, shallow ponds	Insects, fish
Green sunfish	*Lepomis cyanellus*	Ponds and slow flowing streams	Insects, fish

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Bluegill	*Lepomis macrochirus*	Ponds and slow flowing streams	Insects, fish, algae
Redear sunfish	*Lepomis microlephus*	Large, warm rivers, bayous, and lakes	Plankton, insects, mollusks
Largemouth bass	*Micropterus salmoides*	Warm ponds, sluggish waters	Fish, worms, frogs, mussels
Smallmouth bass	*Micropterus dolomieui*	Cool, swift water streams with large pools, and clear lakes	Fish and insects
White crappie	*Pomoxis annularis*	Warm, large, slow rivers	Insects, fish
Black crappie	*Pomoxis nigromaculatus*	Warm, large, slow rivers	Insects, fish
Yellow perch	*Perca flavescens*	Lakes, ponds and quieter parts of streams	Aquatic insects, mollusks and plankton
Logperch	*Percina caprodes*	Turbid, slow moving water	Small insects, crustaceans
Tule perch	*Hysterocarpus traskii*	Sloughs and quiet areas of rivers	Amphipods, isopods, small insect larvae

Table 1: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name	Scientific Name	Habitat	Food Habits
Aleutian sculpin	Cottus aleuticus	Coastal streams	Probably small invertebrates
Prickly sculpin	Cottus asper	Common in small streams	Probably small invertebrates
Riffle sculpin	Cottus gulosus	Stream riffles in rapid flowing streams	Small invertebrates some fish eggs
Pacific staghorn sculpin	Leptocottus armatus	Common inshore and in bays and sloughs	Many small invertebrates and algae
Diamond turbot	Hypsopsetta guttulata	Quiet coastal waters, bays and sloughs	Polychaete worms, clam siphons, shrimp
Starry flounder	Platichthys stellatus	Coastal waters, bays	Adult - some fish, larger crustaceans young - worms, small crustaceans

* The limits of distribution of this species are not well documented, and the presence of this species on a project site is uncertain or questionable.

ǂ California's Fully Protected List, status rare.

Compiled from: Anon., Warmwater Game Fishes of California (1965), Trout of California (1966), A List of Common and Scientific Names of Fishes from the United States and Canada (1960); and Kimsey and Fisk, Freshwater Non-game Fishes of California (1964), Shapovalov, et al., A Revised Check List of the Freshwater and Anadromous Fishes of California.

Table 2: Fishes Whose Distributions Include the Wastewater Land Application Study Sites

Common Name		Wastewater Management Area 4	5	12	18	21	27	28	42	43
Pacific lamprey	Entosphenus tridentata	x	x		x	x	x	x		x
River lamprey	Lampetra ayresii				x					
Brook lamprey	Lampetra planeri				x					
Green sturgeon	Acipenser medirostris	x	x		x	x				x
White sturgeon	Acipenser transmontanus	x	x		x	x				x
American shad	Alosa sapidissima	x	x		x	x	x	x		x
Threadfin shad	Dorosoma petenense	x	x	x	x	x	x	x	x	x
Pacific herring	Clupea harengus pallasi	x								
Slough anchovy	Anchoa delicatissima	x								
Northern anchovy	Engraulis mordax (nanus)	x								
Brown trout	Salmo trutta				x	x				
Rainbow trout	Salmo gairdneri				x	x				
Steelhead rainbow trout	Salmo gairdneri (gairdneri)	x	x		x	x	x	x		x
Chinook (king) salmon	Oncorhynchus tshawytscha	x	x		x	x				x
Coho (silver) salmon	Oncorhynchus kisutch	x	x		x	x		x		x
Pink salmon	Oncorhynchus gorbuscha	x			x					
Chum salmon	Oncorhynchus keta	x			x					
Whitebait smelt	Allosmerus elongatus	x								
Pond smelt	Hypomesus olidus	x								x
Surf smelt	Hypomesus pretiosus	x								
Longfin (Sacramento) smelt	Spirinchus thaleichthys	x						x		x
Tench	Tinca tinca							x		

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Table 2: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name		4	5	12	18	21	27	28	42	43
Goldfish	*Carassius auratus*	x	x	x	x	x	x	x	x	x
Carp	*Cyprinus carpio*	x	x	x	x	x	x	x	x	x
Sacramento western roach	*Hesperoleucus symmetricus (symmetricus)*	x	x							x
Monterey western roach	*Hesperoleucus symmetricus (subditis)*						x			
Venus roach	*Hesperoleucus venustrus*				x	x				
Thicktail chub	*Gila crassicauda*	x								x
Fathead minnow	*Pimephales promelas*	x	x							x
Sacramento hitch	*Lavinia exilicauda (exilicauda)*	x			x	x				x
Monterey hitch	*Lavinia exilicauda (harengus)*						x			
Splittail	*Pogonichthys macrolepidotus*	x			x	x				x
Golden shiner	*Notemigonus crysoleucas*	x	x				x		x	x
Sacramento squawfish	*Ptychocheilus grandis*	x	x							x
Hardhead	*Mylopharodon conocephalus*	x	x		x	x	x			x
Pacific speckled dace	*Rhinichthys osculus (carringtoni)*	x	x							x
Sacramento blackfish	*Orthodon microlepidotus*	x	x							x
Sacramento tui chub	*Siphateles bicolor (formosus)*	x	x							x

Table 2: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name		Wastewater Management Area 4	5	12	18	21	27	28	42	43
Sacramento Western sucker	*Catostomus occidentalis (occidentalis)*	x	x		x	x				x
Monterey sucker	*Catostomus mniotiltus*						x			
Brown bullhead	*Ictalurus nebulosus*	x	x	x	x	x	x	x	x	x
Black bullhead	*I. melas*	x	x	x	x	x	x	x	x	x
Channel catfish	*I. punctalus*	x	x	x	x	x	x			x
White catfish	*I. catus*	x	x	x	x	x	x	x	x	x
Mosquitofish	*Gambusia affinis*	x	x	x	x	x	x	x	x	x
West coast threespine stickleback	*Gasterosteus aculeatus (microcephalus)*	x	x	x	x	x	x	x	x	x
Striped bass	*Morone saxatilis*	x	x		x	x			x	x
Sacramento perch	*Archoplites interruptus*	x					x			x
Warmouth	*Chaenobryttus gulosus*	x	x	x			x		x	x
Green sunfish	*Lepomis cyanellus*	x	x	x	x	x	x	x	x	x
Bluegill	*Lepomis macrochirus*	x	x	x	x	x	x	x	x	x
Redear sunfish	*Lepomis microlophus*	x	x	x	x	x	x	x	x	x
Largemouth bass	*Micropterus salmoides*	x	x	x	x	x	x	x	x	x
Smallmouth bass	*Micropterus dolomieui*		x		x	x				
White crappie	*Pomoxis annularis*	x	x	x	x	x	x	x	x	x
Black crappie	*Pomoxis nigromaculatus*	x	x	x	x	x	x	x	x	x
Yellow perch	*Perca flavenscens*	x	x							x
Logperch	*Percina caprodes*	x	x							x
Tule perch	*Hysterocarpus traskii*	x			x	x	x			x

Table 2: Fishes Whose Distributions Include the Wastewater Land Application Study Sites (continued)

Common Name		4	5	12	18	21	27	28	42	43
Aleutian sculpin	Cottus aleuticus				x			x		
Prickly sculpin	Cottus asper	x			x			x		x
Riffle sculpin	Cottus gulosus				x	x	x	x		
Pacific staghore sculpin	Leptocottus armatus	x			x			x		x
Diamond turbot	Hypsopsetta guttulata	x			x		x	x		x
Starry flounder	Platichthys stellatus	x			x		x	x		x

* The limits of distribution of this species are not well documented, and the presence of this species on a project site is uncertain or questionable.

Table 3

COMMON INSHORE FISHES

Common Name		Scientific Name	Occurrence Site Number 18	Occurrence Site Number 28
Brown smoothhound		Triakis henlei		x
Leopard shark		Triakis semifasciata	x	x
Soupfin shark		Galeorhinus zyopterus	x	x
Spiny dogfish		Squalus acanthias	x	x
Bat ray	+	Myliobatis californicus	x	
Round stingray	+	Urolophus halleri		x
Shovelnose guitarfish	*	Rhinobatos productus		x
Pacific sardine		Sardinops caerulens	x	x
Pacific herring	+	Clupea pallasi	x	x
Round herring		Etrumesus teres	x	x
American shad		Alosa sapidissima	x	x
Northern anchovy		Engraulis mordax	x	x
Steelhead rainbow trout		Salmo gairdneri (gairdeneri)	x	x
Chinook (king) salmon		Oncorhynchus tshawytscha	x	x
Coho (silver) salmon		Oncorhynchus kisutch	x	x
Surf smelt	+	Hypomesus pretiosus	x	x
Whitebait smelt		Allosmerus elongatus	x	x
Night smelt		Spirinchus starksi	x	x
Longfin (Sacramento) smelt	+	Spirinchus thaleichthys	x	
Eulachon	+*	Thaleichthys pacificus	x	
Bay pipefish	+	Syngnathus griseolineatus	x	
Striped bass		Morone saxatilis	x	x
White spotted greenling		Hexagrammos stelleri	x	x
Barred surfperch		Amphistichus agenteus	x	x
Calico surfperch		Amphistichus koelzi		x
Redtail surfperch		Amphistichus rhodoterus	x	x
Shiner surfperch	+	Cymatogaster aggregata	x	x
Walleyed surfperch		Hyperprosopon argenteum	x	x
Silver surfperch		Hyperprosopon ellipticum	x	x
Spotfin surfperch		Hyperprosopon anale	x	x
Striped surfperch		Embiotoca lateralis	x	x
Black perch		Embiotoca jacksoni	x	x
Rainbow surfperch		Hypsurus caryi	x	x
Pile perch		Damalichthys vacca	x	
Rubberlip perch		Rhacochilus toxotes	x	
Reef perch		Amphigonopterus aurora	x	
Dwarf perch	+	Micrometrus minimus	x	x
Arrow goby		Clevelandia ios	x	
Longjaw mudsucker	+*	Gillichthys mirabililis	x	x
White seaperch		Planerodon furcotus	x	
Cabezon		Scorpaenichthys marmoratus	x	

Common Name		Scientific Name	Occurrence Site Number 18	28
Black rockfish		Sebastodes melanops	x	
Flag rockfish		S. rubrivinctus	x	x
Treefish	*	S. serricips		x
China rockfish		S. nebulosus	x	x
Black and yellow rockfish		S. chrysomelas	x	x
Blue rockfish		S. mystinus	x	x
Kelp rockfish		S. atrovirens	x	x
Olive rockfish		S. serranoides	x	x
Grass rockfish		S. rastrelliger	x	x
Lingcod		Ophiodon elongatus	x	x
Pacific staghorn sculpin		Leptocottus armatus	x	x
Buffalo sculpin		Enophrys bison	x	x
Red Irish lord		Hemilepidotus hemilepidotus	x	x
Reef Irish lord		Hemilepidotus spinosus	x	x
Scalyhead sculpin		Artedius harringtoni	x	x
Bonyhead sculpin		Artedius notospilotus	x	x
Padded sculpin		Artedius fenestralis	x	x
Smoothhead sculpin		Artedius lateralis	x	x
Johnny sculpin		Oligocottus maculosus	x	x
Saddleback sculpin		Oligocottus rimensis	x	x
Chameleon sculpin		Oligocottus snyderi	x	x
Wooly sculpin		Clinocottus analis	x	x
Mosshead sculpin		Clinocottus globiceps	x	x
Sharpnose sculpin		Clinocottus acuticeps	x	x
Rubber sculpin		Ascelichthys rhodorus	x	x
Tidepool snailfish		Liparis florae	x	x
Bandtail snailfish		Liparis rutteri	x	x
Weed klipfish		Gibbonsia metzi	x	x
Sarcastic fringehead	*	Neoclinus blanchardi	x	x
Saddleback gunnel		Pholis ornata	x	x
Penpoint gunnel		Apodichthys flavidus	x	x
Rockweed gunnel		Zererpes fucorum	x	x
Monkeyface blenny		Cebidichthys violaceus	x	x
Cockscomb		Anoplarchus purpurescens	x	x
Rock blenny		Xiphister mucosus	x	x
Black prickleback		Epigeichthys atropurpureus	x	x
Jacksmelt	+	Atherinops californiensis	x	x
Topsmelt	+	Atherinops affinis	x	x
California halibut		Paralichthys californicus	x	x
Hornyhead turbot		Pleuronichthys verticalis		x
C-O turbot		Pleuronichthys coenosus	x	x
Diamond turbot	+	Hyposetta guttulata	x	x
Speckled sanddab	+	Citharichthys stigmaeus	x	x
Bigmouth sole		Hippoglossina stomata		x
Rock sole		Lepidopsetta bilineata	x	x
Sand sole		Psettichthys melanostictus	x	x
English sole	+	Parophrys vetulus	x	

Common Name		Scientific Name	Occurrence Site Number 18	28
Scaly-fin sole		Isopsetta isolepis	x	x
Rex sole		Glyptocephalus zachirus	x	x
Starry flounder	+	Platichthys stellatus	x	x
California tonguefish	+	Symphurus atricauda	x	x
Northern clingfish		Gobiesox maeandricus	x	x

* The limits of distribution of this species is not well documented, and the presence of the species on a project site is uncertain or questionable.

\+ Frequently found in bays and sloughs, adult or juvenile life stages.

Compiled from: Anon., A List of Common and Scientific Names of Fishes from the United States and Canada (1960); Baxter, Inshore Fishes of California (1966); Chan and Molina, Conservation of Marine Animals on Duxbury Reef (1969); Clemens and Wilby, Fishes of the Pacific Coast of Canada (1967); and Miller, et al., A Field Guide to some Common Ocean Sport Fishes of California (1965).

Table 4: AMPHIBIANS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Scientific Name	Habitat	Food Habits
		Salamanders	
California tiger salamander	Ambystoma tigrinum californiense	Quiet waters of ponds, lakes, reservoirs, streams, temporary rain pools; under objects or in animal burrows near water; open woodland and grassland areas	Insects, snails, slugs, worms, frogs, salamanders, fish, young rodents
Pacific giant salamander	Dicamptodon ensatus	Damp forests in or near clear, cold streams or seepages; under logs, bark, in rotten wood	Insects, snails, slugs, shrews, mice, amphibians
Northern rough-skinned newt	Taricha granulosa granulosa	Grassland, woodland, forest, under rocks, logs, bark, in rotten wood	Insects, snails, crustaceans, worms, freshwater sponges, spiders
Coast range newt	Taricha torosa torosa	Grassland, woodland, forests-lakes, slow flowing streams	Larvae and adult insects, other invertebrates
Red-belliew newt	Taricha rivularis	In or near streams and rivers of coastal woodlands	Insects, snails, worms, crustaceans, spiders
Ensatina	Ensatina eschscholtzia	Deciduous and evergreen forests under rotting logs, bark or rocks	Insects and other invertebrates
Yellow-eyed salamander	Ensatina eschscholtzia xanthoptica	Deciduous and evergreen forests, under rotting logs, bark or rocks	Insects and other invertebrates

California slender salamander	_Batrachoseps attenuatus_	Grassland with scattered trees, woodland and forest - under logs, bark, litter	Many kinds of small arthropods, worms, slugs
Speckled black salamander	_Aneides flavipunctatus flavipunctatus_	Mixed deciduous woodland and conifer forests, under rocks, talus, logs, bark, boards, etc.	Insects, spiders
Santa Cruz black salamander	_Aneides flavipynctatus niger_	Mixed deciduous woodland and conifer forests; under rocks, talus, logs, bark, boards, etc.	Insects, spiders
Arboreal salamander	_Aneides lugubris_	Live-oak woodland, tree hollows, under logs, rocks	Insects, fungi other salamanders
Western spadefoot toad	_Scaphiopus hammondi_	Short grass plains, pools, ponds, irrigation ditches	Insects
California toad	_Bufo boreas halophilus_	Variety of habitat - grassland, woodland meadows near water	Insects
Pacific treefrog	_Hyla regilla_	Marshes, lakes, ponds, ditches, slow streams, irrigation canals; woods, meadows, grasslands within about one-half mile of water	Small insects
California red-legged frog	_Rana aurora draytoni_	Pond frog - marshes, slow-moving streams	Insects and other arthorpods

Foothill yellow-legged frog	*Rana boylei*	Stream - woodland and forest - near riffles	Aquatic and terrestrial arthropods, especially insects
Bull frog	*Rana catesbeiana*	Quiet water, thick growths of aquatic vegetation	Insects and other invertebrates, small fish, amphibians, reptiles, birds and mammals

Compiled from: Stebbins (1966) *A Field Guide to Western Reptiles and Amphibians*; Stebbins (1951) *Amphibians of Western North America*; Stebbins (1954) *Amphibians and Reptiles of Western North America*; "Vertebrate Check List for Hopland Field Station"; Storer and Usinger (1963) *Sierra Nevada Natural History*.

Table 5

AMPHIBIANS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Site Area 4	5	12	18	21	27	28	42	43
California tiger salamander	x	*	x	x	*	x	x	x	x
Pacific giant salamander	*	x		x	x		x		
Northern rough-skinned newt	x	x		x	x		x	x	x
Coast range newt	x	x	x	x	x	x		x	x
Red-bellied newt					*				
Ensatina	x	x	*	x	x	x	x	*	*
Yellow-eyed salamander	*							*	*
California slender salamander	x	x	*	x	x	x	x	x	x
Speckled black salamander		x		x	x				
Santa Cruz black salamander							x		
Arboreal salamander	x	*	x	x	x	x	x	x	x
Western spadefoot toad	x	x	x		*	x		x	x
California toad	x	x	x	x	x	x	x	x	x
Pacific tree frog	x	x	x	x	x	x	x	x	x
California red-legged frog	x	x	x	x	x	x	x	x	x
Foothill yellow-legged frog	x	x	x	x	x	x	x	x	*
Bullfrog	x	x	x	x	x	x	x	x	x

x Probably occurs on the area.

* Limits of distribution poorly documented; presence of this species on the site is uncertain or questionable.

Table 6: REPTILES WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Scientific Name	Habitat	Food Habits
	Turtles		
Northwestern pond turtle	Clemmys marmorata marmorata	Ponds, marshes (fresh and brackish), streams, rivers, irrigation ditches - rocky or muddy bottom with aquatic vegetation	Aquatic plants, insects, carrion
Southwestern pond turtle	Clemmys marmorata pallida	Ponds, marshes, streams, rivers, irrigation ditches; rocky or muddy bottoms with aquatic vegetation	Aquatic plants, insects, carrion
	Lizards		
Blunt-nosed leopard lizard	Crotaphytus wislizenii silus	Arid and semi-arid plains, with bunch grass, alkali bush, sagebrush, creosote bush, etc. Avoids dense vegetation	Insects, spiders, lizards, small mammals, blossoms, seeds
Yellow-backed spiny lizard	Sceloporus magister uniformis	Arid and semi-arid plains and lower mountain slopes; creosote bush, shad-scale deserts, juniper and mesquite woodlands, riparian willow and cotton-wood thickets	Insects, lizards, buds, leaves
Northwestern fence lizard	Sceloporus occidentalis occidentalis	Great variety of habitats among rocks, logs	Insects, spiders
Northern sage-brush lizard	Sceloporus graciosus graciosus	Open ground, scattered low bushes - found near bushes, brush heaps, rocks, etc.	Insects, spiders, mites, ticks, snails

California side-blotched lizard	Uta stansburiana hesperis	Arid and semi-arid regions; sand, rock, hardpan, or loam with grass, brush, scattered trees. Often in sandy washes with brush or trees	Insects, scorpions, spiders, mites, ticks, sowbugs
California horned lizard	Phrynosoma coronatum frontale	Brushlands, coniferous forests, broad-leaf woodlands; common along sandy washes	Ants and other insects
Desert night lizard	Xantusia vigilis vigilis	Arid areas, under dead clumps of yucca, nolina, agave, cordons, etc.; rock crevices, under logs, debris; beneath bark of digger pines. Sometimes ranges into piñon-jumpier areas.	Insects, spiders, other arthropods
Western skink	Eumeces skiltonianus skiltonianus	Grassland, woodland, forest - rocky habitats near streams	Insects, spiders, sowbugs
Gilberts' skink	Eumeces gilberti	Variety of habitats, grassland, woodland, forests; rocky areas in vicinity of water; under logs or rocks, amid surface cover	Insects, spiders
Variegated skink	Eumeces gilberti cancellosus	Variety of habitats, grassland, woodland, forests; rocky areas in vicinity of water; under logs amid surface cover	Insects, spiders
California whiptail	Cnemidophorus tigris mundus	Semi-arid habitats - woodland, streamside and forest	Insects, spiders, scorpions, other small animals

California alligator lizard	Gerrhonotus multicarinatus multicarinatus	Grasslands, chaparral, oak, woodland and forests; near streams or moist canyon bottoms	Slugs, insects, centipeds, spiders
San Francisco alligator lizard	Gerrhonotus ceoruleus coeruleus	Woodland, forest - under bark, rocks and logs	Insects, spiders, millipeds, snails
Black legless lizard	Anniella pulchra nigra	Loose soil, sand, loam, or leaf mold; beaches, chaparral, pine-oak woodlands, riparian thickets of sycamore, oak, cottomwood	Insects, spiders,
Silvery legless lizard	Anniella pulchra pulchra	Loose soil, sand, loam, or leaf mold; beaches, chaparral, pine-oak woodlands, riparian thickets of sycamore, oak, cottonwood	Insects, spiders
	Snakes		
Pacific rubber boa	Charina bottae bottae	Grassland, woodland and forest, beneath logs, rocks	Small mammals, lizards
Pacific ringneck snake	Diadophis punctatus amabilis	Moist habitats - woodland, grassland, forest, chaparral, farms, gardens, under logs, and rocks	Salamanders, small frogs, lizards, small snakes insects, worms
Northern ringneck snake	Diadophis punctatus occidentalis	Moist habitats - woodland, grassland, forest, chaparral, farms, gardens, under logs, rocks	Frogs, lizards, salamanders, small snakes, insects, worms

Sharp-tailed snake	_Contia tenuis_	Woodlands, grasslands, forests, usually near streams; pastures, open meadows near coniferous forests, or among oaks in lower foothills; under logs, rocks, bark or standing or fallen trees	Slugs
Western yellow-bellied racer	_Coluber constrictor mormon_	Open habitats - thin brush, glades, meadows, prairies - rocks, logs, streamside	Lizards, frogs, small mammals, insects
San Joaquin whipsnake	_Masticophis flagellum ruddocki_	Desert, prairie, brushland, woodland, farmland	Small mammals, birds, bird eggs, lizards, snakes, insects, carrion
Alameda striped racer	_Masticophis lateralis euryxanthus_	Chaparral - foothills, mixed deciduous forests	Frogs, lizards, snakes
California striped racer	_Masticophis lateralis lateralis_	Chaparral - foothills, mixed deciduous forests	Frogs, lizards, snakes
California glossy snake	_Arizona elegans occidentalis_	Chaparral, grassland, brushy desert, barren desert, sagebrush flats, woodlands; prefers open areas	Lizards, snakes, small mammals
Pacific gopher snake	_Pituophis melanoleucus catenifer_	Grasslands, open brush-lands, woodlands	Rodents, rabbits, birds, eggs, lizards
California king-snake	_Lampropeltis getulus californiae_	Many habitats - chaparral coniferous forests, wood-lands, prairie, etc. - rock outcrops, vegetation, logs	Snakes, (including rattlesnakes), lizards, frogs, birds, eggs, small mammals

California mountain king-snake	Lampropeltis zonata	Moist woods, coniferous forests, woodland, and chaparral; rocky streams in wooded areas with rotting logs	Lizards, snakes nestling birds, and small mammals
Coast mountain kingsnake	Lampropeltis zonata multifasciata	Moist woods, conifer forests, woodland, chaparral; rocky streams in wooded areas with rotting logs	Lizards, snakes, nestling birds, small mammals
Saint Helena mountain king-snake	Lampropeltis zonata zonata	Moist woods, conifer forests, woodland, chaparral; rocky streams in wooded areas with rotting logs	Lizards, snakes, nestling birds, small mammals
Western longnose snake	Rhinocheilus lecontei lecontei	Deserts, prairies, brushland	Lizards, lizard eggs, small mammals, insects
Valley garter snake	Thamnophis sirtalis fitchi	Ponds, marshes, streams, sloughs; meadows, woods, city lots; usually near water	Worms, slugs, leeches, fish, toads, frogs, salamanders, small mammals, birds
California red-sided garter snake	Thamnophis sirtalis infernalis	Ponds, marshes, streams, sloughs; meadows, woods, city lots; usually near water	Fish, toads, frogs, salamanders, small mammals, birds, worms, slugs, leeches
San Francisco garter snake	Thamnophis sirtalis titrataenia	Ponds, marshes, streams sloughs; meadows, woods, farms, etc.; usually near water	Fish, toads, frogs, salamanders, birds small mammals, worms, slugs, leeches

Mountain garter snake	Thamnophis elegans elegans	Variety of habitats - grassland, brushland, woodland and forest; sometimes near water	Slugs, leeches, worms, fish, salamanders, frogs, toads, tadpoles, lizards, snakes, small mammals, birds
Coast garter snake	Thamnophis elegans terrestris	Grassland, brushland, woodland, forest; sometimes near water	Slugs, leeches, worms, fish, salamanders, toads, frogs, tadpoles, lizards, snakes, small mammals, birds
Western aquatic garter snake	Thamnophis couchi	Ponds, lakes, streams, rivers, marshes (fresh and brackish)	Fish, fish eggs, frogs, toads, tadpoles, salamanders, worms, leeches
Santa Cruz garter snake	Thamnophis couchi atratus	Ponds, small lakes, sluggish streams	Fish, fish eggs, frogs, toads, tadpoles, salamanders, worms, leeches
Two-striped garter snake	Thamnophis couchi hammondi	Rocky streams with protected pools near shore	Fish, fish eggs, toads, frogs, tadpoles, salamanders, worms, leeches
Giant garter snake	Thamnophis couchi gigas	Streams and sloughs with mud bottoms	Fish fish eggs, frogs, toads, tadpoles, salamanders, worms, leeches
California black headed snake	Tantilla planiceps eiseni	Grassland, woodland, chaparral, desert	Millipeds, centipeds, spiders, probably insects

California night snake	*Hypsiglena torquata nuchalata*	Plains, chaparral, sagebrush flats, woodland, desert	Frogs, lizards
Northern pacific rattlesnake	*Crotalus viridis oreganus*	Wide variety of habitats - grasslands, brushlands, woodland, forest - rock outcrops, talus, rocky stream courses, and ledges	Small mammals birds, lizards, frogs

Compiled from: Stebbins (1966) A Field Guide to Western Reptiles and Amphibians; Stebbins (1954) Amphibians and Reptiles of Western North America; "Vertebrate Check List for Hopland Field Station"; Storer and Usinger (1963) Sierra Nevada Natural History.

Table 7

REPTILES WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Northwestern pond turtle	x	x		x	x			x	x
Southwestern pond turtle	x		x			x	x	x	x
Blunt-nosed leopard lizard			x			x			
Yellow-backed spiny lizard			*			*			
Northwestern fence lizard	x	x	x	x	x	x	x	x	x
Northern sagebrush lizard		x	*	*	x	x			
California side-blotched lizard	*		x			x		x	x
California horned lizard	x	*	x	x	*	x	x	x	x
Desert night lizard			*			*			
Western skink	x	x	x	x	x	x	x	x	x
Gilbert's skink			x						x
Variegated skink			*						*
California whiptail	x	x	x		*	x	*	x	x
California alligator lizard	x	x	x	x	x	x	x	x	x
San Francisco alligator lizard	x	x	x	x	x	x	x	x	x
Black legless lizard						x			
Silvery legless lizard	*		x			x		x	x
Pacific rubber boa	x	x	x	x	x	x	x	x	x
Pacific ringneck snake	x	x	x	x	x	x	x	x	x
Northern ringneck snake		*		*	*				
Sharp-tailed snake	x	x	x	x	x	x	x	x	x
Western yellow-bellied racer	x	x	x	x	x	x	x	x	x
San Joaquin whipsnake	x	x	x			x	x	x	x
Alameda striped racer	x	x	x	x	x	x	x	x	x
California striped racer		*	*		*	*			
California glossy snake			*					x	x
Pacific gopher snake	x	x	x	x	x	x	x	x	x
California kingsnake	x	x	x	x	x	x	x	x	x
California mountain kingsnake			x						
Coast mountain kingsnake			x			x	x		
Saint Helena mountain kingsnake		*		*	x				
Western longnose snake		x	*		*			x	x
Valley garter snake		x	*					x	x
California red-sided garter snake	x	*	x	x	x	x	x	x	*
San Francisco garter snake							x		
Mountain garter snake		x							
Coast garter snake	x	*	x	x	x	x	x	x	*
Western aquatic garger snake	*							*	x
Aquatic garter snake	x	x		x	x				
Santa Cruz garter snake			x			x	x	x	x
Two-striped garter snake			*			*			
Giant garter snake			x					x	x
California black-headed snake			x			x		*	
California night snake	x	x	x			x		x	x
Northern pacific rattlesnake	x	x	x	x	x	x	x	x	x

x Probably occurs in the site area
* Limits of distribution poorly documented; presence of this species in the site area is uncertain or questionable.

Table 8: BIRDS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Scientific Name	Habitat	Food Habits
Common loon	Gavia immer	Lakes, bays, ocean	Small fish and other aquatic animals
Yellow-billed loon	Gavia adamsii	Open water; lakes, bays, ocean	Small fish and other aquatic animals
Arctic loon	Gavia arctica	Open water; lakes, ocean	Small fish and other aquatic animals
Red-throated loon	Gavia stellata	Open water; lakes, bays, estuaries, ocean	Small fish and other aquatic animals
Red-necked grebe	Podiceps grisegena	Coastal water, lakes	Small fish, crustaceans, tadpoles, aquatic insects
Horned grebe	Podiceps auritus	Lakes, ponds; winter-bays, ocean	Small fish, crustaceans, tadpoles, aquatic insects
Eared grebe	Podiceps caspicus	Open water marshes, lakes, bays, ocean	Fish, small crustaceans
Western grebe	Aechmophorus occidentalis	Open water marshes, lakes, sloughs, bays, ocean	Fish, small crustaceans
Pied-billed grebe	Podilymbus podiceps	Open water marshes, ponds, lakes streams, salt bays	Fish, small crustaceans
Black-footed albatross	Diomedea nigripes	Open ocean	Cuttlefish, fish, small marine, animals
Fulmar	Fulmarus glacialis	Ocean	Fish, squid, crustaceans; ships' refuse

Pink-footed shearwater	Puffinus creatopus	Ocean	Fish, squid, crustaceans; ships' refuse
Pale-footed shearwater	Puffinis carneipes	Ocean	Fish, squid, crustaceans; ships' refuse
New Zealand shearwater	Puffinus bulleri	Ocean	Fish, squid, crustaceans, ships' refuse
Scoty shearwater	Puffinus griseus	Ocean	Fish, squid, crustaceans, ships' refuse
Slender-billed shearwater	Puffinus tenuirostris	Ocean	Fish, squid, crustaceans, ships' refuse
Manx shearwater	Puffinus puffinus	Ocean	Fish, squid, crustaceans, ships' refuse
Fork-tailed petrel	Oceanodroma furcata	Ocean, sea islands	Plankton, crustaceans, small fish
Leach's petrel	Oceanodroma leucorhoa	Ocean, sea islands	Plankton, crustaceans, small fish
Ashy petrel	Oceanodroma homochroa	Ocean, sea islands	Plankton, crustaceans, small fish
Black petrel	Loomelania melania	Ocean	Plankton, crustaceans, small fish
White pelican	Pelecanus erythrorhynchos	Open water marsh, lakes, salt bays, beaches	Fish, crustaceans
Brown pelican	Pelecanus occidentalis	Salt bays, ocean	Fish, crustaceans
Double-crested cormorant	Phalacrocorax auritus	Coast, bays, lakes, rivers	Fish, crustaceans

Brandt's cormorant	<u>Phalacrocorax penicillatus</u>	Ocean, coast, littoral areas	Fish, crustaceans
Pelagic cormorant	<u>Phalacrocorax pelagicus</u>	Coasts, bays, sounds	Fish, crustaceans
Great blue heron	<u>Ardea herodias</u>	Marshes, streams grasslands, tide-flats, shores	Fish, frogs, cray-fish, mice, insects
Green heron	<u>Butorides virescens</u>	Fresh marsh, lakes, slow streams	Fish, frogs, cray-fish, mice, insects
Little blue heron	<u>Florida caerulea</u>	Marshes, streams shores, tideflats	Fish, frogs, cray-fish, other aquatic life, insects, mice
Cattle egret	<u>Bubulcus ibis</u>	Pastures, grasslands, often associated with grazing animals	Insects
Common egret	<u>Casmerodius albus</u>	Marshes, ponds, shores, mudflats irrigated lands	Fish, frogs, cray-fish, insects, other aquatic life
Snowy egret	<u>Leucophoyx thúla</u>	Marshes, ponds, tideflats, shores, irrigated lands	Fish, frogs, cray-fish, insects, other aquatic life
Black-crowned night heron	<u>Nycticorax nycticorax</u>	Marshes, lake margins, shores	Fish, frogs, cray-fish, insects, other aquatic life
Least bittern	<u>Ixobrychus exilis</u>	Marshes, ponds	Fish, frogs, cray-fish, insects, other aquatic life
American bittern	<u>Botaurus lentiginosus</u>	Marshes, lakes	Fish, frogs, cray-fish, insects, other aquatic life

Wood ibis	Mycteria americana	Marshes, ponds, lagoons	Frogs, crustaceans, lizards, rodents
White-faced ibis	Plegadis chihi	Fresh marshes	Crustaceans, insects, leeches, small fish
Whistling swan	Olor columbianus	Open water, marshes, large rivers, bays, estuaries, fields	Aquatic plants, seeds
Trumpeter swan	Olor buccinator	Lakes, ponds, large rivers; winter, also bays	Aquatic plants; reeds
Canada goose	Branta canadensis	Lakes, bays, marshes, grain fields	Grasses, seeds, aquatic plants
Brant	Branta bernicla	Salt bays, ocean, mudflats	eelgrass, other aquatic plants
Black brant	Branta nigricans	Salt bays, ocean, mudflats	eelgrass, other aquatic plants
White-fronted goose	Anser albifrons	Marshes, prairies, fields, lakes, bays	Grasses, seeds, aquatic plants
Snow goose	Chen hyperborea	Grain fields, ponds, prairies, lakes, bays	Grasses, seeds, aquatic plants
Blue goose	Chen caerulescens	Grain fields, ponds, prairies, lakes, bays	Grasses, seeds, aquatic plants
Ross' goose	Chen rossii	Grain fields, ponds, prairies, lakes bays	Grasses, seeds, aquatic plants
Fulvous tree duck	Dendrocygna bicolor	Fresh marshes, irrigated fields	Grass seeds

Mallard	Anas platyrhynchos	Fresh marshes, irrigated fields, ponds, rivers, lakes, bays	Aquatic plants grass seeds, insects, aquatic animals
Gadwall	Anas strepera	Lakes, ponds, rivers fresh marshes	Aquatic plants grass seeds, insects, aquatic animals
Pintail	Anas acuta	Marshes, prairies, ponds, lakes, salt bays	Aquatic plants, grass seeds, insects, aquatic animals
Common teal	Anas crecca	Marshes, lakes, ponds, rivers, bays	Aquatic plants; seeds
Green-winged teal	Anas carolinensis	Marshes, lakes, ponds, rivers, bays	Aquatic plants, grass seeds, insects, aquatic animals
Blue-winged teal	Anas discors	Fresh ponds, marshes	Aquatic plants, seeds, grass, small aquatic animals, insects
Cinnamon teal	Anas cyanoptera	Fresh ponds, rivers, marshes	Aquatic plants, seeds, grass, small aquatic animals, insects
European widgeon	Mareca penelope	Fresh marshes, irrigated land, ponds, lakes, bays	Aquatic plants, seeds, grass, small aquatic animals, insects
American widgeon	Mareca americana	Fresh marshes, ponds, lakes, bays	Aquatic plants, seeds, grass, small aquatic animals, insects

Shoveler	<u>Spatula</u> <u>clypeata</u>	Marshes, ponds, sloughs; winter-salt bays	Aquatic plants, seeds, grass, small aquatic animals, insects
Wood duck	<u>Aix</u> <u>sponsa</u>	Wooded swamps, rivers, ponds	Aquatic plants, seeds, grass, small aquatic animals, insects
Redhead	<u>Aythya</u> <u>americana</u>	Marshlands, lakes, estuaries	Small aquatic animals and plants; mollusks, crustaceans
Ring-necked duck	<u>Aythya</u> <u>collaris</u>	Coniferous lakes, wooded ponds, marsh ponds, rivers, bays	Small aquatic animals and plants; mollusks, crustaceans
Canvasback	<u>Aythya</u> <u>valisineria</u>	Fresh marshes, lakes, salt bays, estuaries	Small aquatic animals and plants; mollusks, crustaceans
Greater scaup	<u>Aythya</u> <u>marila</u>	Lakes, rivers, salt bays, estuaries	Small aquatic animals and plants; mollusks, crustaceans
Lesser scaup	<u>Aythya</u> <u>affinis</u>	Fresh marshes, lakes, salt bays, estuaries	Small aquatic animals and plants; mollusks, crustaceans
Tufted duck	<u>Aythya</u> <u>fuligula</u>	Marshes, lakes, bays, estuaries	Small aquatic animals and plants; mollusks, crustaceans
Common golden-eye	<u>Bucephala</u> <u>clangula</u>	Lakes, rivers, salt bays, ocean	Small aquatic animals and plants; mollusks, crustaceans
Barrow's golden-eye	<u>Bucephala</u> <u>islandica</u>	Rivers, coastal waters	Small aquatic animals and plants; mollusks, crustaceans

Bufflehead	Bucephala albeola	Lakes, ponds, rivers, salt bays	Small aquatic animals and plants; mollusks, crustaceans
Oldsquaw	Clangula hyemalis	Ocean, lakes	Small aquatic animals and plants; mollusks, crustaceans
Harlequin duck	Histrionicus histrionicus	Rough coastal waters; turbulent streams	Small aquatic animals and plants; mollusks, crustaceans
White-winged scoter	Melanitta deglandi	Salt bays, ocean	Small aquatic animals and plants; mollusks, crustaceans
Surf scoter	Melanitta perspicillata	Ocean surf, salt bays	Small aquatic animals and plants; mollusks, crustaceans
Common scoter	Oidemia nigra	Coastal areas	Small aquatic animals and plants; mollusks, crustaceans
Ruddy duck	Oxyura jamaicensis	Fresh marshes, ponds, lakes, salt bays	Small aquatic life insects, aquatic plants
Hooded merganser	Lophodytes cucullatus	Wooded lakes, ponds, and rivers	Fish
Common merganser	Mergus merganser	Lakes, rivers, ponds, rarely bays	Fish
Red-breasted merganser	Mergus serrator	Lakes, bays, ocean	Fish
Turkey vulture	Cathartes aura	Aerial	Carrion
White-tailed kite	Elanus leucurus	Open foothills, river valleys, marshes	Insects, reptiles, small mammals

Goshawk	<u>Accipiter</u> <u>gentilis</u>	Northern forests, mountain woodlands	Birds, some mammals
Sharp-shinned hawk	<u>Accipiter</u> <u>striatus</u>	Forests, thickets	Chiefly birds, some mammals
Cooper's hawk	<u>Accipiter</u> <u>cooperii</u>	Broken woodlands, canyons, river groves	Chiefly birds, some mammals
Red-tailed hawk	<u>Buteo</u> <u>jamaicensis</u>	Open country, woodlands	Rodents, rabbits, small birds, reptiles
Harlan's hawk	<u>Buteo</u> <u>harlani</u>	Open country, woodlands, mountains, deserts	Rodents, rabbits
Red-shouldered hawk	<u>Buteo</u> <u>lineatus</u>	Broken woodland	Rodents, rabbits, small birds, reptiles
Swainson's hawk	<u>Buteo</u> <u>swainsoni</u>	Dry plains, open foothills, rangeland, open forest, sparse trees	Rats, mice, grasshoppers, gophers
Rough-legged hawk	<u>Buteo</u> <u>lagopus</u>	Plains, marshes	Rodents, rabbits, small birds, reptiles
Ferruginous hawk	<u>Buteo</u> <u>regalis</u>	Plains, rangeland	Rodents, rabbits, small birds, reptiles
Golden eagle	<u>Aquila</u> <u>chrysaetos</u>	Open mountains, foothills, canyons, plains	Rabbits, large rodents
Bald eagle	<u>Haliaeetus</u> <u>leucocephalus</u>	Lakes, rivers, coast	Dead or dying fish

Marsh hawk	Circus cyaneus	Marshes, fields, prairies	Rodents, small birds, insects
Osprey	Pandion haliaetus	Rivers, lakes, coast	Fish
Prairie falcon	Falco mexicanus	Canyons, plains, prairies, open mountains	Birds, rodents
Peregrine falcon	Falco peregrinus	Open country	Birds, rodents, insects
Pigeon hawk	Falco columbarius	Open woodland, foot-hills, valleys; in oaks	Birds, rodents, insects
Sparrow hawk	Falco sparverius	Wooded streams, farm-land, open country	Rodents, insects, a few small birds
California quail	Lophortyx californicus	Broken chaparral, woodland edges, farms, coastal scrub	Insects, seeds, berries
Mountain quail	Oreortyx pictus	Brushy forest and farmland	Insects, seeds, berries
Ring-necked pheasant	Phasianus colchicus	Irrigated land, farmland	Insects, seeds berries
Chukar	Alectoris graeca	Rocky, grassy, or brushy slopes; arid mountains, canyons	Insects, seeds, buds, berries
Turkey	Meleagris gallopavo	Broken woodland	Insects, seeds, buds, berries

Sandhill crane	*Grus canadensis*	Prairies, grain-fields, marshes	Rodents, frogs, insects
Clapper rail	*Rallus longirostris*	Salt marshes, brackish marshes, fresh marshes	Aquatic plants, insects, frogs, crustaceans, mollusks
Virginia rail	*Rallus limicola*	Fresh marshes, tules, salt marshes	Aquatic plants, insects, frogs, crustaceans, mollusks
Sora	*Porzana carolina*	Fresh marsh, wet meadows; salt marshes (in winter)	Aquatic plants, insects, frogs, crustaceans, mollusks
Yellow rail	*Coturnicops noveboracensis*	Grassy fresh marshes; salt marshes (rarely)	Aquatic plants, insects, frogs, crustaceans, mollusks
Black rail	*Laterallus jamaicensis*	Tidal marshes, *Salicornia*	Aquatic plants, insects, crustaceans, mollusks
Common gallinule	*Gallinula chloropus*	Fresh marshes, reedy ponds	Aquatic plants, insects, frogs, crustaceans, mollusks, seeds, buds
American coot	*Fulica americana*	Ponds, lakes, marshes; salt bays (in winter)	Aquatic plants, insects, frogs, crustaceans, mollusks, seeds, buds
Black oyster-catcher	*Haematopus bachmani*	Rocky coasts, sea islets	Oysters, other bivalves, crabs, marine worms
Semipálmated plover	*Charadrius semipalmatus*	Shores, tideflats	Small marine life, insects

Snowy plover	Charadrius alexandrinus	Beaches, sandflats alkali flats	Small marine life, insects
Killdeer	Charadrius vociferus	Fields, riverbanks, irrigated lands, shores	Insects, small aquatic animals
Mountain plover	Eupoda montana	Grasslands, plains, plateaus	Insects
American golden plover	Pluvialis dominica	Prairies, mudflats shores	Small marine life, insects
Black-bellied plover	Squatarola squatarola	Mudflats, open marshes, shores	Small marine life, insects
Surfbird	Aphriza virgata	Rocky coasts	Small marine life, insects
Ruddy turnstone	Arenaria interpres	Surf-swept rocks, beaches, mudflats	Small marine life, insects
Black turnstone	Arenaria melanocephala	Rocky shores, bay, shores, breakwaters	Small marine life, insects
Common snipe	Capella gallinago	Streamside, irrigation ditches, bogs, wet meadows	Insects, small crustaceans, mollusks, worms, other invertebrates
Long-billed curlew	Numenius americanus	High plains, rangelands; winter, also: farms, tidelands, beaches, salt marshes	Insects, other invertebrates, some seeds, berries
Whimbrel	Numenius phaeopus	Shores, tideflats, open marshes, prairies	Insects, small crustaceans, mollusks, worms, other invertebrates

Spotted sandpiper	Actitis macularia	Lakeshore, streamside; ponds, winter also: seashores	Insects, small crustaceans, mollusks, worms, other invertebrates
Solitary sandpiper	Tringa solitaria	Streamsides, wooded swamps, ponds, fresh marshes	Insects, crustaceans, mollusks, worms, other invertebrates
Wandering tattler	Heteroscelus incanum	Rocky coast, pebbly beaches	Insects, small crustaceans, mollusks, worms, other invertebrates
Willet	Catoptrophorus semipalmatus	Fresh marshes, wet meadows; winter: beaches, tideflats, salt marshes	Insects, small crustaceans, mollusks, worms, other invertebrates
Greater yellowlegs	Totanus melanoleucus	Streams, ponds, open marshes, mudflats	Insects, small crustaceans, mollusks, worms, other invertebrates
Lesser yellowlegs	Totanus flavipes	Marshes, mudflats, shores, pond edges	Insects, crustaceans, mollusks, worms, other invertebrates
Knot	Calidris canutus	Tideflats, shores	Insects, small crustaceans, mollusks, worms, other invertebrates
Rock sandpiper	Erolia ptilocnemis	Rocky shores	Insects, small crustaceans, mollusks, worms, other invertebrates
Pectoral sandpiper	Erolia melanotos	Marshy shores, tidal marshes	Insects, small crustaceans, mollusks, worms, other invertebrates

Baird's sandpiper	Erolia bairdii	Rainpools, pond margins, mudflats, shores	Insects, small crustaceans, mollusks, worms, other invertebrates
Least sandpiper	Erolia minutilla	Marshland, riverbars, tideflats, shores	Insects, crustaceans, mollusks, worms, other invertebrates
Dunlin	Erolia alpina	Marshland, muddy pools, beaches, tideflats	Insects, crustaceans, mullusks, worms, other invertebrates
Short-billed dowitcher	Limnodromus griseus	Mudflats, open marshes, ponds	Insects, small crustaceans, mollusks, worms, other invertebrates
Long-billed dowitcher	Limnodromus scolopaceus	Mudflats, shallow pools	Insects, small crustaceans, mollusks, worms, other invertebrates
Stilt sandpiper	Micropalama himantopus	Shallow pools ponds, mudflats, marshes	Insects, crustaceans, mollusks, worms, other invertebrates
Semipalmated sandpiper	Ereunetes pusillus	Beaches, shores, mudflats	Insects, crustaceans, mollusks, worms, other invertebrates
Western sandpiper	Ereunetes mauri	Open marshes, shores, beaches, mudflats	Insects, small crustaceans, mollusks, worms, other invertebrates
Marbled godwit	Limosa fedoa	Shores, beaches, tideflats	Insects, small crustaceans, mollusks, worms, other invertebrates
Hudsonian godwit	Limosa haemastica	Lake shores, prairie pools	Insects, crustaceans, mullusks, worms, other invertebrates

Ruff	<u>Philomachus</u> <u>pugnax</u>	Tideflats, shores, beaches	Insects, small crustaceans, mollusks, worms, other invertebrates
Sanderling	<u>Crocethia</u> <u>alba</u>	Beaches, tideflats, lake shores	Insects, small crustaceans, mollusks, worms, other invertebrates
American avocet	<u>Recurvirostra americana</u>	Open marshland, flooded fields	Insects, crustaceans, other small quatic life
Black-necked stilt	<u>Himantopus</u> <u>mexicanus</u>	Grassy marshes, mudlfats, pools, shallow lakes	Insects, crustaceans, small aquatic life
Red phalarope	<u>Phalaropus fulicarius</u>	Open ocean, coastal estuaries, bays	Plankton, marine invertebrates, brine shrimp, mosquito larvae, insects
Wilson's phalarope	<u>Steganopus</u> <u>tricolor</u>	Fresh marshes, shallow lakes, pools, shores, mudflats, salt marshes	Plankton, marine invertebrates, brine shrimp, mosquito larvae, insects
Northern phalarope	<u>Lobipes</u> <u>lobatus</u>	Ocean, lakes, ponds, bays	Plankton, marine invertebrates, brine shrimp, mosquito larvae, insects
Pomarine jaeger	<u>Stercorarius pomarinus</u>	Open ocean, bays, sounds	Food taken from gulls and terns; fish, other marine life
Parasitic jaeger	<u>Stercorarius parasiticus</u>	Open ocean, bays, sounds	Food taken from gulls and terns; fish, other marine life

Glaucous gull	Larus hyperboreus	Coastal waters	Plant and animal marine life, refuse, carrion
Glaucous-winged gull	Larus glaucescens	Ocean, coast, bays, beaches, piers, waterfronts, refuse dumps	Plant and animal marine life, refuse, carrion
Western gull	Larus occidentalis	Coastal waters, estuaries, beaches piers, waterfront areas	Plant and animal marine life, refuse, carrion
Herring gull	Larus argentatus	Ocean, coast, bays, beaches, lakes, piers, farmland, refuse dumps	Plant and animal aquatic life, refuse, carrion
California gull	Larus californicus	Coast, beaches, piers, lakes, rivers, farmland	Plant and animal aquatic life, refuse, carrion
Ring-billed gull	Larus delawarensis	Coast, bays, estuaries, lakes, rivers, piers, refuse dumps, fields	Plant and animal aquatic life, refuse, carrion
Mew gull	Larus canus	Coastal waters, tidal rivers, lakes	Plant and animal aquatic life, refuse, carrion
Franklin's gull	Larus pipixcan	Prairies, marshes, lakes; in winter coast, ocean	Plant and animal aquatic life, refuse, carrion
Bonaparte's gull	Larus philadelphia	Ocean, bays, rivers lakes	Plant and animal aquatic life, refuse, carrion
Heermann's gull	Larus heermanni	Coast and open ocean	Plant and animal aquatic life, refuse, carrion

Black-legged kittiwake	Rissa tridactyla	Open ocean; bays (rarely)	Fish
Sabine's gull	Xema sabini	Ocean	Plant and animal marine life
Forster's tern	Sterna forsteri	Fresh and salt marshes, bays, ocean, lakes, beaches	Small fish, large insect, marine animals
Common tern	Sterna hirundo	Ocean, bays, beaches	Small fish, other marine life, large insects
Arctic tern	Sterna paradisaea	Ocean, coast	Small fish, other marine life, large insects
Least tern	Sterna albifrons	Beaches, bays, ocean, estuaries	Small fish, other marine life, large insects
Elegant tern	Thalasseus elegans	Coastal areas	Small fish, other marine life, large insects
Caspian tern	Hydroprogne caspia	Coast, bays, lakes	Small fish, other marine life, large insects
Black tern	Chlidonias niger	Fresh marshes, lakes, coast	Small fish, other marine life, large insects
Common murre	Uria aalge	Ocean, large bays; sea cliff, sea island	Fish, crustaceans, mollusks, algae
Pigeon guillemot	Cepphus columba	Rocky coasts, ocean; sea cliff	Fish, crustaceans, mollusks, algae
Marbled murrelet	Brachyramphus marmoratum	Coastal waters, bays, tide-rips	Fish, crustaceans, mollusks, algae

Xantus' murrelet	Endomychura hypoleuca	Ocean	Fish, crustaceans, mollusks, algae
Ancient murrelet	Synthliboramphus antiquum	Open ocean, sounds, rarely bays; islands	Fish, crustaceans, mollusks, algae
Cassin's auklet	Ptychoramphus aleutica	Ocean; sea islands.	Fish, curstaceans mollusks, algae
Parakeet auklet	Cyclorrhynchus psittacula	Ocean	Fish, crustaceans mollusks, algae
Rhinoceros auklet	Cerorhinca monocerata	Ocean, tide-rips	Fish, curstaceans mollusks, algae
Tufted puffin	Lunda cirrhata	Ocean; islands, headlands	Fish, crustaceans, mollusks, algae
Band-tailed pigeon	Columba fasciata	Oak canyons, foot-hills, chaparral	Seeds, grain, insects
Rock dove	Columba livia	Cities, farms, cliffs	As above
Mourning Dove	Zenaidura macroura	Farmland, open woods, coastal scrub	Seeds, grain, insects
California yellow-billed cuckoo	Coccyzus americanus	Dense riparian growth	Caterpillars and other insects
California roadrunner	Geococcyx californianus	Open country with scattered cover	Insects
Barn owl	Tyto alba	Woodland, groves fields, canyons, farms, cliffs	Rodents
Screech owl	Otus asio	Woodlands, wooded canyons, farm groves	Largely insects

Great horned owl	Bubo virginianus	Forests, woodlands, open country, deserts, canyons, cliffs, streamsides, chaparral	Rabbits, rodents, birds
Pygmy owl	Glaucidium gnoma	Mixed woods, wooded canyons, open coniferous forests	Rabbits, rodents, reptiles, insects
Burrowing owl	Speotyto conicularia	Open prairies, farms; grasslands, deserts	Insects, rodents, reptiles, birds
Spotted owl	Strix occidentalis	Heavy forests, conifers, wooded canyons	Rodents, insects
Long-eared owl	Asio otus	Riparian woods, willow thickets, live oak; mountain forests; junipers	Rodents, a few birds
Short-eared owl	Asio flammeus	Prairies, salt marshes, fresh marshes, irrigated land, dunes	Rodents, birds, reptiles
Saw-whet owl	Aegolius acadicus	Forests, conifers groves	Rodents, reptiles, insects
Poor-will	Phalaenoptilus nuttallii	Arid hills, sparse brush	Flying insects
Common nighthawk	Chordeiles minor	Plains, open pine woods, open countryside, towns	Flying insects
Lesser nighthawk	Chordeiles acutipennis	Arid open scrub, dry grassland, fields, prairies, gravelly desert, washes	Flying insects

Black swift	Cypseloides niger	Mountainous country, coastal cliffs	Flying insects
Vaux's swift	Chaetura vauxi	Forest burns, forest openings	Flying insects
White-throated swift	Aeronautes saxatalis	Canyons, sea cliffs	Flying insects
Black-chinned hummingbird	Archilochus alexandri	Semi-arid, near water chaparral, river groves, foothill suburbs	Flower nectar, small insects
Costa's hummingbird	Calypte costae	Deserts, mesas, sage scrub, arid hillsides	Flower nectar; aphids, small insects, spiders
Anna's hummingbird	Calypte anna	Chaparral, broken woodland	Flower nectar, small insects
Rufous hummingbird	Selasphorus rufus	Forest edges, streamside	Flower nectar, small insects
Allen's hummingbird	Selasphorus sasin	Wooded or bushy canyons, meadows	Flower nectar, small insects
Calliope hummingbird	Stellula calliope	High mountains; canyons, forest glades	Flower nectar; aphids, small insects, spiders
Belted kingfisher	Megaceryle alcyon	Rivers, ponds, lakes	Fish
Yellow-shafted flicker	Colaptes auratus	Groves, riparian woods, open forest, canyons, semi-open country, farms, towns	Ants, tree-boring insects, grasshoppers, berries

Red-shafted flicker	Colaptes cafer	River woods, open forest, canyons	Ants, tree-boring insects, grasshoppers, berries.
Pileated woodpecker	Dryocopus pileatus	Coniferous and mixed forest	Tree-boring insects
Acorn woodpecker	Melanerpes formicivorus	Oak wood, mixed forest, foothills	Acorns; flying insects
Lewis' woodpecker	Asyndesmus lewis	Scattered or logged forest, river groves, burns	Acorns, flying insects
Yellow-bellied sapsucker	Sphyrapicus varius	Woodland, aspen groves, orchards	Tree sap
Hairy woodpecker	Dendrocopos villosus	River groves, woodlands	Tree-boring insects
Downy woodpecker	Dendrocopos pubescens	Woods, broken and mixed forest, river groves, willows, poplars, orchards	Tree-boring insects
Nuttall's woodpecker	Dendrocopus nuttallii	Wooded canyons and foothills, river woods, groves, orchards	Tree-boring insects
Tropical kingbird	Tryannus melancholicus	Riparian groves, scattered trees	Flying insects
Western kingbird	Tryannus verticalis	Open country with scattered trees, farms, roadsides	Flying insects

Cassin's kingbird	Tyrannus vociferans	Semi-open high country, scattered trees; pine-oak mountains; ranch groves	Flying insects
Ash-throated fly-catcher	Myiarchus cinerascens	Semi-arid brush mesquite, open woods, piñon-juniper	Flying insects
Eastern phoebe	Sayornis phoebe	Streamsides, farms, roadsides, towns	Flying insects
Black phoebe	Sayornis nigricans	Shady streams, walled canyons, farmyards, towns; near water	Flying insects
Say's phoebe	Sayornis saya	Open arid country, canyon mouths; buttes, farms, brushy plains	Flying insects
Traill's flycatcher	Empidonax traillii	Willow and alder thickets in valleys, canyons, swamps, or meadows; brushy bogs	Flying insects
Least flycatcher	Empidonax minimus	Open woodlands, poplar and aspen groves, orchards	Flying insects
Hammond's flycatcher	Empidonax hammondii	Coniferous forests; other trees during migrations	Flying insects

Dusky flycatcher	Empidonax oberholseri	Mountain chaparral, open conifer forest	Insects
Western flycatcher	Empidonax difficilis	Moist woods, mixed or conifer woods, groves, canyons; near water	Flying insects
Western wood peewee	Contopus sordidulus	Woodlands, pine-oak forests, river groves, open conifers	Flying insects
Olive-sided flycatcher	Nuttallornis borealis	Conifer forests, burns, eucalyptus groves	Flying insects
Horned lark	Eremophila alpestris	Plains, fields, golf courses, priaires, sparse sage flats	Seeds, some insects
Violet-green swallow	Tachycineta thalassina	Open forests, foot-. hill woods, canyons, cliffs	Flying insects
Tree-swallow	Iridoprocne bicolor	Open country near water, marshes, streams, lakes	Flying insects
Bank swallow	Riparia riparia	Near water; fields, marshes, streams, lakes	Flying insects
Rough-winged swallow	Stelgiopteryx ruficollis	Near lakes, streams washes	Flying insects
Barn swallow	Hirundo rustica	Semi-woods, farms, fields, marshes	Flying insects
Cliff swallow	Petrochelidon pyrrhonota	Semi-woods, cliffs, canyons, farms, rivers, lakes	Flying insects

Purple martin	Progne subis	Open forest, lumbered forests, towns, farms	Flying insects
Stellers jay	Cyanocitta stelleri	Conifers, pine-oak forests	Seeds, nuts, insects, small mammals, refuse
Scrub jay	Aphelocoma coerulescens	Foothills, oak, river woods, chaparral, piñon, junipers	Acorns, insects, eggs, and young birds
Yellow-billed magpie	Pica nuttalli	Stream groves, scattered oaks, ranches, farms	Insects, seeds
Common raven	Corvus corax	Canyons, cliffs, boreal forest	Omnivorous
Common crow	Corvus brachyrhynchos	Woodlands, farmland, river groves, shores	Omnivorous
Clark's nutcracker	Nucifraga columbiana	High mountains; conifers near tree line	Pine nuts, seeds, carrion, insects
Chestnut-backed chickadee	Parus rufescens	Moist conifer forests, adjacent oaks, etc.	Insects
Plain titmouse	Parus inornatus	Oak woods, piñon, junipers, river woods	Insects
Common brushtit	Psaltriparus minimus	Oak scrub, chaparral, mixed woods, piñons, junipers	Insects
White-breasted nuthatch	Sitta carolinensis	Mixed forests, groves, river woods	Insects, seeds, nuts

Red-breasted nuthatch	Sitta canadensis	Conifer forests, also other trees in winter	Insects, nuts
Pygmy nuthatch	Sitta pygmaea	Pines, Douglas fir	Insects, seeds, nuts
Brown creeper	Certhia familiaris	Mature forest groves	Insects, spiders
Wrentit	Chamaea fasciata	Chaparral, brush, parks, garden shrubs	Insects, berries
Dipper	Cinclus mexicanus	Fast-flowing streams	Insects, fish
House wren	Troglodytes aedon	Thickets, open woods, brush, towns	Insects, spiders
Winter wren	Troglodytes troglodytes	Coniferous forests, woodland underbrush	Insects, spiders
Bewick's wren	Thryomanes bewickii	Thickets, underbrush, chaparral, piñons, junipers	Insects, spiders
Long-billed marsh wren	Telmatodytes palustris	Marshes; tule, cat-tails, bulrush; brackish marshes	Insects, spiders
Short-billed marsh wren	Cistothorus platensis	Grassy marshes, sedges	Insects, spiders
Cañon wren	Catherpes mexicanus	Cliffs, canyons, rock slides	Insects, spiders
Rock wren	Salpinctes obsoletus	Rocky slopes, walls, rock dams, tulus	Insects, spiders
Mockingbird	Mimus polyglottos	Farm, brush, ranches, towns, mesquite	Insects, fruits

California thrasher	Toxostoma redivivum	Chaparral, foothills, valley thickets, parks, gardens	Insects, fruits
Le Conte's thrasher	Toxostoma lecontei	Desert flats with sparse bushes, especially of Atriplex	Insects, fruit
Sage thrasher	Oreoscoptes montanus	Sagebrush, brushy slopes, mesas; winter, also deserts	Insects, fruit
Robin	Turdus migratorius	Farmland, open forest, stream-side, towns	Insects, worms, snails, berries, fruits
Varied thrush	Ixoreus naevius	Woods, ravines, thickets, conifers	Insects, snails, berries, fruit, worms
Hermit thrush	Hylocichla guttata	Conifer or mixed woods, forest floor, thickets	Insects, worms, snails, berries
Swainson's thrush	Hylocichla ustulata	Willow thickets, river woods, aspens, forest undergrowth	Insects, worms, snails, berries
Western bluebird	Sialia mexicana	Scattered trees, open conifer forest, brush, farms	Insects, berries
Mountain bluebird	Sialia currucoides	Open terrain, scattered trees	Insects, berries

Townsend's solitaire	*Myadestes townsendi*	Mountain forests, canyons, brushy slopes, junipers	Insects, worms, snails, berries, fruits
Blue-gray gnatcatcher	*Polioptila caerulea*	Open mixed woods, oaks, chaparral, pinon, juniper; winter - riparian woods and thickets	Insects, insect eggs and larvae
Golden-crowned kinglet	*Regulus satrapa*	Conifers, other trees in winter	Insects, insect eggs and larvae
Ruby-crowned kinglet	*Regulus calendula*	Conifer forests, woodlands, thickets	Insects, insect eggs and larvae
Water pipit	*Anthus spinoletta*	Tundra, alpine zone; winter-plains, fields, shores	Insects, spiders, seed
Bohemian waxwing	*Bombycilla garrula*	Boreal forest; winter - widespread	Insects, berries
Cedar waxwing	*Bombycilla cedrorum*	Open woodland, orchards	Berries, insects
Phainopepla	*Phainopepla nitens*	Desert scrub, mesquite oak foothills	Berries, mistletoe insects
Northern shrike	*Lanius excubitor*	Semi-open or open country	Insects, lizards, mice
Loggerhead shrike	*Lanius ludovicianus*	Open country, low scrub, scattered trees	Insects, lizards, mice, small birds
Starling	*Sturnus vulgaris*	Farms, open country, open groves, fields	Insects, fruits, grains

Hutton's vireo	Vireo huttoni	Woods (oaks), brush	Insects
Bell's vireo	Vireo bellii	Riparian willow thickets, mesquite	Insects
Solitary vireo	Vireo solitarius	Mixed forests, pine oak woods	Insects
Red-eyed vireo	Vireo olivaceus	Woodlands, shade trees, groves	Insects
Warbling vireo	Vireo gilvus	Deciduous and mixed woods, groves, aspen, poplars	Insects
Black-and-white warbler	Mniotilta varia	Woodlands; trunks and limbs of trees	Insects
Orange-crowned warbler	Vermivora celata	Brushy woodland, hillsides, chaparral, undergrowth, aspens	Insects
Nashville warbler	Vermivora ruficapilla	Open mixed woods with undergrowth, forest edges	Insects
Parula warbler	Parula americana	Deciduous and coniferous woods	Insects
Yellow warbler	Dendroica petechia	Willows, poplars, streamside trees, shrubs, shade trees	Insects
Magnolia warbler	Dendroica magnolia	Low conifers; other trees during migrations	Insects

Myrtle warbler	Dendroica coronata	Conifers, mixed forests; winter - woods, river thickets, brush, gardens	Insects
Audubon's warbler	Dendroica auduboni	Conifer forest; winter-tree tops, brush, thickets, open woods, beaches	Insects, small fruits
Black-throated gray warbler	Dendroica nigrescens	Dry oak slopes, piñons, open mixed woods, junipers	Insects
Townsend's warbler	Dendroica townsendi	Oaks, madroñas, laurels	Insects
Black-throated green warbler	Dendroica virens	Conifer forests	Insects
Hermit warbler	Dendroica occidentalis	Conifer forests, other trees	Insects
Blackpoll warbler	Dendroica striata	Low conifers, other trees	Insects
Ovenbird	Seiurus aurocapillus	Near ground in deciduous woods, thickets	Insects
MacGillivray's warbler	Oporornis tolmiei	Low dense undergrowth; shady, damp thickets	Insects
Yellowthroat	Geothlypis trichas	Swamps, marshes (fresh and salt), streamside, wet thickets	Insects

Yellow-breasted chat	_Icteria virens_	Stream tangles, willow thickets, moist canyons	Insects
Wilson's warbler	_Wilsonia pusilla_	Moist tangles, stream thickets, low shrubs, willows, alders	Insects
American redstart	_Setophaga ruticilla_	Second-growth deciduous woods, alders	Insects
House sparrow	_Passer domesticus_	Cities, towns, farms	Insects, seeds
Western meadowlark	_Sturnella neglecta_	Open fields, meadows, plains	Insects, fruit, seed
Yellow-headed blackbird	_Xanthocephalus xanthocephalus_	Fresh marshes, tules; fields, open country	Insects, seeds, fruit, small aquatic life
Red-winged blackbird	_Agelaius phoeniceus_	Marshes, hay fields, edges of water, cultivated land	Insects, seeds, fruit, small aquatic life
Tricolored blackbird	_Agelaius tricolor_	Marshy areas, tules; fields, irrigated land	Insects, seeds, fruit, small aquatic life
Hooded oriole	_Icterus cucullatus_	Open woodlands, thickets, shade trees, palms	Insects, small fruits, seeds, grain, small aquatic life
Scott's oriole	_Icterus parisorum_	Dry woods and scrub in desert mountains; oak slopes, piñons, Joshua trees, yucca	Insects, small fruits, seeds

Bullock's oriole	Icterus bullockii	River groves, open oak woods, towns, farms	Insects, small fruits, seeds, waste grain, small aquatic life
Brewer's blackbird	Euphagus cyanocephalus	Open country, lake-shore, fields, farms, towns	Insects, small fruits, seeds, waste grain, small aquatic life
Brown-headed cowbird	Molothrus ater	Farms, fields, river groves, wood edges	Insects, small fruits seeds, waste grain, small aquatic life
Western tanager	Piranga ludoviciana	Open conifer, mixed forest	Insects, fruit, berries
Summer tanager	Piranga rubra	Riparian woods, cottonwoods, willow groves	Insects, small fruit
Black-headed grosbeak	Pheucticus melanocephalus	Pine-oak, mixed forest, streamside groves, orchards, chaparral, piñon	Seeds, insects, fruit
Blue grosbeak	Guiraca caerulea	Brushy, weedy places; willows, riparian thickets	Seeds, insects, small fruits
Indigo bunting	Passerina cyanea	Brush, shrubland	Seeds, insects, small fruits
Lazuli bunting	Passerina amoena	Sage, streamside, briars, burns, broken brushy slopes	Seeds, insects small fruits

Evening grosbeak	Hesperiphona vespertina	Conifers; winter - box elders, maples, fruiting shrubs	Seeds, insects, small fruits, some tree buds
Purple finch	Carpodacus purpureus	Woodland (mixed and conifer)	Buds, catkins, berries
Cassin's finch	Carpodacus cassinii	Open conifer forests of high mountains	Buds, seeds, small fruits, insects
House finch	Carpodacus mexicanus	Open woods, coastal scrub, canyons, towns, ranches	Seeds, berries, fruits
Pine siskin	Spinus pinus	Conifer forest, mixed forest, tree tops, alders	Buds, catkins, seeds
American goldfinch	Spinus tristis	River groves, orchards, willows, poplars, roadsides	Buds, seeds
Lesser goldfinch	Spinus psaltria	Open brushy country, wooded stream, open woods	Buds, seeds
Lawrence's goldfinch	Spinus lawrencei	Open oak or oak-pine woods, dry chaparral, edges	Seeds, insects, small fruits
Red crossbill	Loxia curvirostra	Conifer forests and groves	Seeds of conifers

Green-tailed towhee	Chlorura chlorura	Dry brushy mountain slopes; low chaparral, open pines, sage, manzanita	Seeds, insects, small fruits
Rufous-sided towhee	Pipilo erythrophthalmus	Brush, chaparral, undergrowth, forest edges	Seeds
Brown towhee	Pipilo fuscus	Brushy, stony areas; canyons, open woods, chaparral, piñon-juniper	Seeds
Lark bunting	Calamospiza melanocorys	Plains, prairies, arid brush, desert scrub	Seeds, insects, small fruits
Savannah sparrow	Passerculus sandwichensis	Prairies, fields, meadows, open counrty salt marshes, shores	Seeds, insects
Grasshopper sparrow	Ammodramus savannarum	Grassland, hay meadows, prairies	Seeds, insects, small fruits
Vesper sharrow	Pooecetes gramineus	Fields with sparse brush, open country, sagebrush, roadsides	Seeds, insects, small fruits
Lark sparrow	Chondestes grammacus	Open country, open brush, farm	Seeds, insects, small fruits
Rufous-crowned sparrow	Aimophila ruficeps	Grassy or rocky slopes, open pine woods	Seeds, insects

Sage sparrow	Amphispiza belli	Dry brushy foothills, open chaparral, sagebrush, plains; winter, also deserts	Seeds, insects, small fruits
Slate-colored junco	Junco hyemalis	Coniferous and mixed woods, undergrowth, roadsides, brush	Seeds, insects, small fruits
Oregon junco	Junco oreganus	Conifer and mixed forest, roadside, brush	Seeds
Chipping sparrow	Spizella passerina	Open woodland, conifers, farm, orchards, towns	Insects, seeds, fruit
Brewer's sparrow	Spizella breweri	Sagebrush, brushy plains, weedy fields	Seeds, insects, small fruits
Black-chinned sparrow	Spizella atrogularis	Brushy mountain slopes, open chaparral, sagebrush	Seeds, insects, small fruits
Harris' sparrow	Zonotrichia querula	Stunted boreal forests; winter-brushy edges, open woodlands	Seeds, insects, small fruits
White-crowned sparrow	Zonotrichia leucophrys	Scattered cover, low brush, boreal scrub, open scrub, towns, roadsides	Seeds, insects

Golden-crowned sparrow	*Zonotrichia atricapilla*	Boreal scrub; spruce; winter-closed scrub, brush	Seeds, insects
White-throated sparrow	*Zonotrichia albicollis*	Woodland undergrowth, thickets, brush	Seeds, insects, small fruits
Fox sparrow	*Passerella iliaca*	Chaparral, boreal woodland, forest undergrowth	Seeds
Lincoln's sparrow	*Melospiza lincolnii*	Willow, alder, brushy bogs; winter-thickets, tall weeds, bushes	Seeds, insects
Swamp sparrow	*Melospiza geogiana*	Brushy marshes, muskegs	Seeds, insects, small fruits
Song sparrow	*Melospiza melodia*	Thickets, marsh, brush, roadsides	Seeds, insects
Lapland longspur	*Calcarius lapponicus*	In winter, fields, prairies	Seeds, insects, small fruits
Chestnut-collared longspur	*Calcarius ornatus*	Plains, prairies	Seeds, insects, small fruits

Compiled from: *Audubon Birds*, 26(s), 1972; Peterson (1961) *A Field Guide to Western Birds*; McCaskie and de Bendictis (1966) *Birds of Northern California*; Mall, "Suisun Marsh Fauna"; Robbins, et. al. (1966) *Birds of North America*; Grinnel and Miller (1944) *The Distribution of the Birds of California*; Wilbur, "Los Banos Checklist"; *Checklist, Birds of Palo Alto* (1970); "Vertebrate Check List for Hopland Field Station"; Arnold, "The Birds of Bodega Bay"; Johnson, et. al. (1971) *Biological Characteristics of Tomales Bay*; *California Fish and Wildlife Plan* Vol. III Part A (1965); Storer and Usinger, (1963) *Sierra Nevada Natural History*.

Table 9

BIRDS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

	Site Area								
Common Name	4	5	12	18	21	27	28	42	43
Common loon	+		*	+	+	*	+	x	+
Yellow-billed loon				+					
Arctic loon			+	+			+		
Red-throated loon				+			+		
Red-necked grebe			+	+			+		
Horned grebe	+		+	+	+	*	+	*	*
Eared grebe	+	+	+	+	+	x	+	x	x
Western grebe	+	x	+	+	+	x	+	+	x
Pied-billed grebe	+	+	+	+	+	x	+	+	+
Black-footed albatross				+			x		
Fulmar				+			x		
Pink-footed shearwater				+			x		
Pale-footed shearwater							*		
New Zealand shearwater				x			x		
Sooty shearwater				+			x		
Slender-billed shearwater				+			x		
Manx shearwater				*			x		
Fork-tailed petrel				+			x		
Leach's petrel				+			x		
Ashy petrel				+			x		
Black petrel				+			x		
White pelican	+	*	+	+	*	*	+	*	*
Brown pelican				+			+		
Double-crested cormorant	+	+	+	+	+	x	+	+	x
Brandt's cormorant				+			+		
Pelagic cormorant				+			+		
Great blue heron	+	+	+	+	+	x	+	+	+
Green heron	x	+	+	+	+	x	+	+	+
Little blue heron (1)			+	+					
Cattle egret			+	+					
Common egret	+	+	+	+	+	x	+	+	x
Snowy egret	+	+	+	+	+	x	+	+	x
Black-crowned night heron	+	x	+	+	+	x	+	+	x
Least bittern	x	x	+	+	+	x	x	x	x
American bittern	+	+	+	+	+	x	+	+	+
Wood ibis		+							
White-faced ibis	+	*	+		*	*		*	*
Whistling swan	+	+	+	+	+	x	*	x	+
Trumpeter swan				+	+				
Canada goose	+	+	+	+	+	x	+	+	+
Brant				+			*		
Black brant			+	+			x		
White-gronted goose	+	+	+	+	*	x	+	x	+
Snow goose	+	+	+	+	*	*		x	+
Blue goose (1)	*	*	+	*	*	*		*	*

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Ross' goose	+	x	+		*	x		x	x
Fulvous tree duck	*	*	+		*	*		x	x
Mallard	+	+	+	+	+	x	+	+	+
Gadwall	+	+	+	+	+	x	+	+	x
Pintail	+	+	+	+	+	x	+	+	+
Common teal	+								
Green-winged teal	+	x	+	+	+	x	+	+	x
Blue-winged teal	+	*	+	x	x	*	x	x	x
Cinnamon teal	+	x	+	+	+	x	+	x	x
European widgeon		*	+					+	
American widgeon	+	+	+	+	+	x	+	+	x
Shoveler	+	+	+	+	+	x	+	+	+
Wood duck	+	+	+	+	+	x	+	x	x
Redhead	+	x	+	+	+	x	+	x	x
Ring-necked duck	+	x	+	+	+	x	+	x	x
Canvasback	+	x	+	+	+	x	+	+	x
Greater scaup	+	+	+	+	+		+		
Lesser scaup	+	x	+	+	+	x	+	+	x
Tufted duck (1)				+					
Barrow's goldeneye				+			x		
Bufflehead	+	x	+	+	+	x	+	x	+
Oldsquaw				+			x		
'larlequin duck				+			*		
White-winged scoter				+			+		
Surf scoter	+			+			+		
Common scoter				+			+		
Ruddy duck	+	+	+	+	+	x	+	+	x
Hooded merganser	+	x	+	+	+	*	+	*	*
Common merganser	+	+	+	+	+	x	+	x	x
Red-breasted merganser	+			+			+		
Turkey vulture	+	+	+	+	+	x	+	+	x
White-tailed kite	+	+	+	+	+	x	+	+	+
Goshawk		*	+	+	+				
Sharp-shinned hawk	+	+	+	+	+	x	+	+	+
Cooper's hawk	+	+	+	+	+	x	+	+	+
Red-tailed hawk	+	+	+	+	+	x	+	+	+
Harlan's hawk (1)			+						
Red-shouldered hawk	+	+	+	+	+	x	+	x	x
Swainson's hawk	+	+	+	+	x	x	+	x	x
Rough-legged hawk	+	x	+	+	x	x	+	x	x
Ferruginous hawk	+	+	+	+	+	x	x	x	x
Golden eagle	+	+	+	+	+	x	+	+	x
Bald eagle	*	*	+	+	+	*	+	*	*
Marsh hawk	+	+	+	+	+	x	+	+	x
Osprey	x	x	+	+	+	x	x	x	x
Prairie falcon	+	*	+	+	*	*		+	*
Peregrine falcon	+	*	+	+	+	*	+	*	*
Pigeon hawk	+	+	+	+	+	x	x	x	x
Sparrow hawk	+	+	+	+	+	x	+	+	+

	Site Area								
Common Name	4	5	12	18	21	27	28	42	43
California quail	+	+	+	+	+	x	+	+	+
Mountain quail					+				
Ring-necked pheasant	+	+	+	+	+	x	+	+	+
Chukar			*			*		*	
Turkey		x			x	*			
Sandhill crane		x	+	+				*	+
Clapper rail				+		x	+		
Virginia rail	+	*	+	+	+	x	x	+	x
Sora	+	*	+	+	+	x	x	x	+
Yellow rail	+	*	*	+	+	*	*	*	*
Black rail	+			+		*	*		
Common gallinule	+	+	+	+	+	x	x	+	+
American coot	+	+	+	+	+	x	+	+	+
Black oystercatcher				+			+		
Semipalmated plover	+	*	+	+	*	x	+	x	x
Snowy plover			+	+	x		+	x	x
Killdeer	+	+	+	+	+	x	+	+	+
Mountain plover		*	+	+	*			x	
American golden plover		+		+	*		*	*	*
Black-bellied plover	+	x	+	+	+	x	+	x	+
Surfbird				+			+		
Ruddy turnstone			+	+			+		
Black turnstone				+			+		
Common snipe	+	x	+	+	+	x	+	+	+
Long-billed curlew	+	x	+	+	+	x	+	x	+
Whimbrel	+	*	+	+		x	+	x	x
Spotted sandpiper	+	x	+	+	+	x	+	x	x
Solitary sandpiper	*	*	+	+	*	*		*	*
Wandering tattler				+			+	+	
Willet	+	x	+	+	*	x	+	+	+
Greater yellowlegs	+	+	+	+	+	x	+	x	+
Lesser yellowlegs	+	*	+	+	*	x	+		x
Knot				+			+		
Rock sandpiper				+					
Pectoral sandpiper	+	x	+	+	*	x	*	x	x
Baird's sandpiper	*	*	*	+	*	*	*	x	x
Least sandpiper	+	x	+	+	+	x	+	+	+
Dunlin	+	+	+	+	+	x	+	+	+
Short-billed dowitcher	x	x	x	+	x	x	+	x	x
Long-billed dowitcher	+	x	+	+	+	x	+	+	+
Stilt sandpiper		x	+	+	*				
Semi-palmated sandpiper				+					
Western sandpiper	+	x	+	+	+	x	+	+	+
Marbled godwit	+	*	+	+	*	x	+	*	*
Hudsonian godwit (1)				+					
Ruff (1)				+					
Sanderling				+			+		
American avocet	+	x	+	+	x	x	+	+	x

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Black-necked stilt	+	x	+	+	x	x	+	+	x
Red phalarope				+			x		
Wilson's phalarope	+	x	+	+	x	x	x	x	+
Northern phalarope	+	x	+	+	+	x	x	x	x
Pomarine jaeger				+			x		
Parasitic jaeger				+			x		
Glaucous gull	+			+			x	+	
Glaucous-winged gull	+	*	+	+	+	x	+	+	x
Western gull				+			+		
Herring gull	+	+	+	+	+	x	+	+	+
California gull	+	+	+	+	+	x	+	+	+
Ring-billed gull	+	+	+	+	+	x	+	+	+
Mew gull	+			+	+		+	+	+
Franklin's gull	*	*	+	*			x		
Bonaparte's gull	+		+	+	+	x	+	+	+
Heermann's gull				+			+		
Black-legged kittiwake				+			x		
Sabine's gull		*		+					
Forster's tern	*	*	+	+	*	x	+	x	*
Common tern		+		+			x		
Arctic tern				+			x		
Least tern				+			x		
Elegant tern				+			x		
Caspian tern	+	x	+	+	x	x	+	x	*
Black tern	*	x	+	x	x	x	x	x	*
Common murre				+			+		
Pigeon guillemot				+			x		
Marbled murrelet				+			+		
Xantus' murrelet							*		
Ancient murrelet				+					
Cassin's auklet				x					
Parakeet auklet				+			*		
Rhinoceros auklet				+			x		
Tufted puffin				+					
Band-tailed pigeon		+	*	+	+	x	+	+	x
Rock dove		x	x	x	+	x		x	x
Mourning dove	+	+	+	+	+	x	+	+	+
Yellow-billed cuckoo		*	*	+	*	*		*	*
California roadrunner		x	+		+	x		*	
Barn owl	+	x	+	+	+	x	+	+	+
Screech owl	*	x	x	+	+	x	+	x	x
Great horned owl	+	+	+	+	+	x	+	x	x
Pygmy owl		+		+	+		x		
Burrowing owl	+	x	+	+	+	x	+	x	+
Spotted owl		*		+	+				
Long-eared owl	+	*	x	+	+	x	+	x	x
Short-eared owl	+	*	+	+	x	x	+	x	x
Saw-whet owl	*	*	*	+	+	*	+	*	*

Common Name	4	5	12	18	21	27	28	42	43
					Site Area				
Poor-will		x		+	+	*	*	x	x
Common nighthawk		x	x	+	+				
Lesser nighthawk	*	*	+		*	x	*	x	x
Black swift				+	*		x		
Vaux's swift		x	x	+	x	x	x	*	*
White-throated swift		+	+	+	*	x	+	+	x
Black chinned hummingbird	*	x	+			*	x	x	x
Costa's hummingbird			x			*		x	
Anna's hummingbird	+	+	+	+	+	x	+	+	x
Rufous hummingbird	+	x	+	+	+	x	x	x	x
Allen's hummingbird	+	x	+	+	+	x	x		x
Calliope hummingbird		*	+		*	*	*	x	x
Belted kingfisher	+	+	+	+	+	x	+	+	+
Yellow-shafted flicker	+	+	*	+	+	*	+	*	*
Red-shafted flicker	+	+	+	+	+	x	+	+	+
Pileated woodpecker				+	+				
Acorn woodpecker		+	+	+	+	x	+	+	+
Lewis' woodpecker		+	+	+	+	x		+	x
Yellow-bellied sapsucker		+	+	+	+	x	+	+	+
Hairy woodpecker		+	*	+	+	*	+	+	*
Downy woodpecker		+	+	+	+	x	+	+	+
Nuttall's woodpecker		+	+	+	+	x	+	+	+
Tropical kingbird				+			*		
Western kingbird	+	+	+	+	+	x	x	x	x
Cassin's kingbird	*		+			x		x	x
Ash-throated flycatcher		+	+	+	+	x	+	x	x
Eastern phoebe (1)			+						
Black phoebe	+	+	+	+	+	x	+	+	+
Say's phoebe	+	+	+	+	+	x	+	+	x
Traill's flycatcher	+	*	*	+	x	*	*	x	x
Least flycatcher				+					
Hammond's flycatcher			*	+	x	*	*		
Dusky flycatcher		*	*		*	x		*	
Western flycatcher	+	x	+	+	+	x	x	x	x
Western wood pewee	+	*	+	+	+	x	x	x	x
Olive-sided flycatcher		x	*	+	x	*	x		
Horned lark	+	+	+	+	+	x	+	+	x
Violet-green swallow	*	x	+	+	+	x	+	+	x
Tree swallow	+	+	+	+	*	x	x	x	x
Bank swallow	*	*	+	+		*	x	x	x
Rough-winged swallow	*	x	+	+	+	x	x	x	x
Barn swallow	+	x	+	+	x	x	x	x	x
Cliff swallow	+	x	+	+	x	x	x	x	x
Purple martin		x	*	x	+	x	x	x	x
Steller's jay	+	+	*	+	+	x	+	+	x
Scrub jay	+	+	+	+	+	x	+	+	+
Yellow-billed magpie	x	+	+	+		x	+	x	+
Common raven	+	x	+	+	+	x	x	x	x
Common crow	+	+	+	+	+	x	+	+	+

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Clark's nutcracker		*	*		*		*		
Chestnut-backed chickadee				+	+		+	+	
Plain titmouse	+	+	+	+	+	x	+	+	+
Common bushtit	+	+	+	+	+	x	+	+	+
White-breasted nuthatch		+	+	+	+	x	+	+	+
Red-breasted nuthatch		x	+	+	+	x	+	+	x
Pygmy nuthatch				+	+		+		
Brown creeper		x	x	+	+	x	+	+	+
Wrentit		+		+	+	x	+	+	x
Dipper		+		x	x		+		
House wren	+	x	+	+	x	x	x	x	+
Winter wren		*		+	+	x	+	x	
Bewick's wren	+	+	+	+	+	x	+	+	+
Long-billed marsh wren	+	+	+	+	+	x	+	+	+
Short-billed marsh wren (1)				+					
Cañon wren		+	+			*	+	x	
Rock wren	+	+	+	+		*	*	+	
Mockingbird	+	+	+	+	+	x	+	+	+
California thrasher	*	+	+	+	+	x	+	+	x
Le Conte's thrasher			x			*			
Sage thrasher	+		+			*			
Robin	+	+	+	+	+	x	+	+	+
Varied thrush	+	+	+	+	+	x	+	+	+
Hermit thrush	+	+	+	+	+	x	+	+	+
Swainson's thrush	+	x	+	+	x	x	x	x	x
Western bluebird		+	+	+	+	x	+	+	x
Mountain bluebird		x	+		*				
Townsend's solitaire		*	*	+	*				
Blue-gray gnatcatcher		x	x	+	+	x	+	x	x
Golden-crowned kinglet	*	+	*	+	+	*	+	x	+
Ruby-crowned kinglet	+	+	+	+	+	x	+	+	+
Water pipit	+	+	+	+	+	x	+	+	+
Bohemian waxwing		x	x	+	x	x	x	x	x
Cedar waxwing	+	+	+	+	+	x	+	+	+
Phainopepla		+	+		*	*		x	x
Northern shrike	+	x		+	*				
Loggerhead shrike	+	+	+	+	+	x	+	+	+
Starling	+	+	+	+	+	x	+	+	+
Hutton's vireo		+	+	+	+	*	+	*	
Bell's vireo		*	*					*	*
Solitary vireo		x	*		*		x	x	x
Red-eyed vireo				+					
Warbling vireo		x	+	+	+	x	x	x	x
Black-and-white warbler	*			+			*		
Orange-crowned warbler	+	+	+	+	+	x	+	x	x
Nashville warbler	+		*	+					
Parula warbler (1)				+					
Yellow warbler	+	x	+	+	+	x	x	x	x

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Magnolia warbler (1)					+				
Myrtle warbler	+	+	+	+	+	x	+	+	x
Audubon's warbler	+	+	+	+	+	x	+	+	+
Black-throated gray warbler	*	*	+	+	+	*	x	x	x
Townsend's warbler	+	*	+	+	+	*	+	x	+
Black-throated green warbler							+		
Hermit warbler	+	*		+	x	*	+	x	x
Blackpoll warbler				+			*		
Ovenbird				+					
MacGillivray's warbler	+	*	*	+	+	*		x	x
Yellowthroat	+	x	+	+	x	x	+	+	+
Yellow-breased chat	*	x	*	+	x	x	*	*	x
Wilson's warbler	+	x	+	+	x	x	+	x	x
American redstart				*	*	x	x		
House sparrow	+	+	+	+	+	x	+	+	+
Western meadowlark	+	+	+	+	+	x	+	+	+
Yellow-headed blackbird	+	x	+	+	*	x	x	x	x
Red-winged blackbird	+	+	+	+	+	x	+	+	+
Tricolored blackbird	+	+	+	+	+	x	+	x	x
Hooded oriole	*	*	*	+	*	x	x	x	x
Scott's oriole			x			x		*	*
Bullock's oriole	*	x	+	+	+	x	x	x	x
Brewer's blackbird	+	+	+	+	+	x	+	+	+
Brown-headed cowbird	+	+	+	+	+	x	+	x	+
Western tanager	+	x	+	+	+	x	x	x	+
Summer tanager	+								
Black-headed grosbeak	+	x	+	+	+	x	x	x	
Blue grosbeak	+	x	+	+	*	*		x	
Indigo bunting (1)		*			*	*			
Lazuli bunting	*	x	*	+	+	x	x	x	
Evening grosbeak		x	*	+	+	x	*	*	
Purple finch	+	+	*	+	+	x	+	+	x
Cassin's finch	*	*			*	*	*	*	*
House finch	+	+	+	+	+	x	+	+	+
Pine siskin		*	*	+	+	*	+	+	
American goldfinch	+	+	+	+	+	x	+	+	+
Lesser goldfinch	+	+	+	+	+	x	+	+	+
Lawrence's goldfinch		+	*	+	+	x	+	x	+
Red crossbill		*	*	+	x	*	x	*	
Green-tailed towhee		*	*				*	*	
Rufous-sided towhee	+	+	+	+	+	x	+	+	+
Brown towhee	+	+	+	+	+	x	+	+	+
Lark bunting (1)		+		+					
Savannah sparrow	+	+	+	+	+	x	+	+	+
Grasshopper sparrow	+		+	x	*	*	*	*	*
Vesper sparrow	+	+	+	+	*	x	x	x	x
Lark sparrow	+	+	+	+	+	x	+	+	+
Rufous-crowned sparrow		x	+	+	+	x	+	+	
Sage sparrow		x	+		+	x	x	x	

Common Name	Site Area 4	5	12	18	21	27	28	42	43
Slate-colored junco		+		+	+		*		
Oregon junco	+	+	+	+	+	x	+	+	+
Chipping sparrow	*	x	+	+	+	x	+	x	x
Brewer's sparrow			*	*		*	*	x	
Black-chinned sparrow		*	x			x		x	
Harris' sparrow		+		+		*	*	*	
White-crowned sparrow	+	+	+	+	+	x	+	+	+
Golden-crowned sparrow	+	+	+	+	+	x	+	+	+
White-throated sparrow	*	+	*	+	+	x	x	+	x
Fox sparrow	+	+	+	+	+	x	+	+	+
Lincoln's sparrow	+	+	+	+	+	x	+	x	x
Swamp sparrow	*			+		*	x		
Song sparrow	+	+	+	+	+	x	+	+	+
Lapland longspur		*		*	*				
Chestnut collared longspur (1)				+					

\+ On the 1971 Christmas Bird Count or on one of the other local lists, referenced in the bibliography, for a location on or near the wastewater management area.

x Probably occurs on the area.

* The presence of this species on the area is uncertain or questionable.

(1) Very uncommon; a vagrant or straggler well outside of its normal range.

Table 10: MAMMALS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Scientific Name	Habitat	Food Habits
	Marsupials		
Opossum	*Didelphis marsupialis*	Farming areas preferred, also found in woodlands and along streams	Fruits, vegetables, nuts, meals, eggs, insects and carrion
	Insectivores		
Trowbridge shrew	*Sorex trowbridgei*	Coniferous forests and other wooded areas	Insects, isopods, Douglas fir seeds
Vagrant shrew	*Sorex vagrans*	Marshes, bogs, wet meadows, also along streams in forests	Insects, other small invertebrates
Pacific shrew	*Sorex pacificus*	Redwood and spruce forests, marshes, swamps	Insects, worms, slugs other invertebrates; some plant matter
Ornate shrew	*Sorex ornatus*	Near streams and in wet meadows	Insects
Suisun shrew	*Sorex sinuosus*	Brackish marshes	Insects, other small invertebrates
Shrew-mole	*Neurotrichus gibbsi*	Moist areas in shady ravines; along streams in areas free of turf	Mostly small invertebrates
California mole	*Scapanus latimanus*	Porous soils in valleys, meadows in mountains	Insects and other small invertebrates
	Bats		
Little brown myotis	*Myotis lucifugus*	Caves, mine tunnels, hollow trees, or building serve as roosting places	Insects on the wing

Yuma myotis	Myotis yumanensis	Caves, tunnels, or buildings; arid areas	Insects
Long-eared myotis	Myotis evotis	Thinly forested areas, around buildings or trees; occasionally caves	Insects
Fringed myotis	Myotis thysanodes	Caves, attics of old buildings	Insects
Long-legged myotis	Myotis volans	Buildings, small pockets and crevices in rock ledges	Insects
California myotis	Myotis californicus	Mine tunnels, hollow trees, loose rocks, buildings, bridges; chiefly a crevice dweller	Insects
Small-footed myotis	Myotis subulatus	Mine tunnels, hollow trees, loose rocks, buildings, bridges; chiefly a crevice dweller	Insects
Silver-haired bat	Lasionycteris noctivagans	Forested area, buildings, caves	Insects, feeds among trees
Western pipistrel	Pipistrellus hesperus	Caves, under loose rocks, crevices in cliffs, buildings, arid conditions but near watercourses	Insects
Big brown bat	Eptesious fuscus	Caves, tunnels, crevices, hollow trees, buildings, wooded areas	Insects, chiefly beetles
Red bat	Lasiurus borealis	Wooded areas; normally roosts in trees, occasionally caves	Insects
Hoary bat	Lasiurus cinereus	Wooded areas	Insects
Western big-eared bat	Plecotus townsendi	Caves, mine tunnels and buildings for roosts	Insects

Pallid bat	*Antrozous pallidus*	Caves, mine tunnels, crevices in rocks, buildings, trees for roosts	Beetles, Jerusalem crickets and other large insects
Mexican freetail bat	*Tadarida brasiliensis*	Caves and buildings for roosts	Moths
Western mastiff bat	*Eumops perotis*	Buildings, cliffs, trees, tunnels	Insects
		Carnivores	
Black bear	*Ursus americanus*	Mountainous areas	Omnivorous vegetation, fruits, insects, small mammals
Raccoon	*Procyon lotor*	Along streams and lakes' borders where there are wooded areas or rocky cliffs nearby	Feeds along streams and lakes - omnivorous feeds on "anything available"
Ringtail	*Bassariscus astutus*	Chaparral, rocky ridges and cliffs near water	Small mammals, birds, insects, fruit
Marten	*Martes americana*	Fir, spruce, and hemlock forests	Chiefly red squirrels and other small mammal
Fisher	*Martes pennanti*	Mixed hardwood forests, cut-over wilderness areas	Small mammals, birds, carrion, and fruit
Shorttail weasel	*Mustela erminea*	Brushy or wooded areas, usually not far from water	Mice and other small mammals
Longtail weasel	*Mustela frenata*	Found in all land habitats that are near water	Small mammals - up to rabbit size
Mink	*Mustela vison*	Along streams and lakes	Small mammals, birds, eggs, fish
River otter	*Lutra canadensis*	Along streams and lake borders	Fish, frogs, crayfish and other aquatic invertebrates

Sea otter	Enhydra lutris	Kelp beds and rocky shores	Sea urchins, mollusks, other marine invertebrates
Badger	Taxidea taxus	Open grasslands	Small burrowing rodents
Spotted skunk	Spilogale putorius	Brushy or sparsely wooded areas, along streams among boulders	Mice, birds, eggs, insects, carrion, and vegetation
Striped skunk	Mephitis mephitis	Semi-open country; mixed woods, brushland, and open prairie	Mice, eggs, insects, grubs, berries, carrion
Coyote	Canis latrans	Prairies, open woodlands, brushy or boulder - strewn areas	"True scavenger" - almost any animal or vegetable matter
Red fox	Vulpes fulva	Mixture of forests and open country	Insects, rodents, hares, berries, fruits
Kit fox	Vulpes macrotis	Open, level, sandy ground; low desert vegetation; junipers	Rodents
Gray fox	Urocyon cinereo argenteus	Chaparral, open forests, rimrock country	Omnivorous - primarily small mammals
Mountain lion	Felis concolor	Rugged mountains, forests, swamps	Deer, hares, rodents; some domestic animals
Bobcat	Lynx rufus	Rimrock, chaparral areas	Small mammals, birds
	Rodents		
Mountain beaver	Aplodontia rufa	Forests and dense thickets, usually moist situations	Herbaceous plants and shrubs
California ground squirrel	Citellus beecheyi	Pastures, grain fields, slopes with scattered trees; rocky ridges - avoids thick chaparral and dense woods	Green vegetation, seeds, acorns, mushrooms, fruits, birds, eggs and insects

San Joaquin antelope squirrel	Ammospermophilus nelsoni	Dry, sparsely vegetated areas	Seeds, insects
Townsend chipmunk	Eutamias townsendi	Coniferous forests and adjacent areas	Vegetation, seeds, nuts, insects, fruits
Sonoma chipmunk	Eutamias sonomae	Chaparral, brushy clearings, stream thickets, warm slopes	Vegetation, seeds, nuts, insects, fruits
Merriam chipmunk	Eutamias merriami	Chaparral slopes; mixed oak and digger pine forests; riparian thickets; rock outcrops, foothills	Seeds, nuts, fruits, other plant matter; insects
Western gray squirrel	Sciurus griseus	Oak and pine-oak forests, fairly open	Acorns and seeds of conifers
Chickaree	Tamiasciurus douglasi	Coniferous forest	Seeds, nuts, eggs, fungi
Northern flying squirrel	Glaucomys sabrinus	Coniferous forest and mixed forest	Seeds, nuts, insects, and bird eggs
Valley pocket gopher	Thomomys bottae	Valley and mountain meadows - prefers loam but also occurs in sandy or rocky areas	Roots, tubers, and surface vegetation
Little pocket mouse	Perognathus longimembris	Valleys and slopes; sandy soil covered with desert pavement of small pebbles; sagebrush croesote bush, and cactus; occasionally, scattered piñons and junipers	Seeds
San Joaquin pocket mouse	Perognathus inornatus	Dry, open, trass, or weedy areas; fine textured soils	Seeds

California pocket mouse	Perognathus californicus	Chaparral of live-oak slopes	Seeds
Heermann kangaroo rat	Dipodomys heermanni	Dry grassy plains, sparse chaparral with open gravelly ground	Green vegetation seeds
Giant kangaroo rat	Dipodomys ingens	Fine sandy loam with sparse vegetation	Green vegetation, seeds
Santa Cruz kangaroo rat	Dipodomys venustus	Slopes with chaparral, oaks, pines; flat areas up to 6,000 feet elevation	Green vegetation, seeds
Big-eared kangaroo rat	Dipodomys elephantinus	Chaparral covered slopes	Green vegetation, seeds
Fresno kangaroo rat	Dipodomys nitratoides	Arid, often alkaline plains with sparse grass and low brush	Green vegetation, seeds
Beaver	Castor canadensis	Streams or lakes with trees or alders on their banks	Bark of cottonwood, aspen and willow
Western harvest mouse	Reithrodontomys megalotis	Grassland, open desert, weed patches usually dense vegetation and near water	Seeds, insects
Salt marsh harvest mouse	Reithrodontomys raviventris	Salt marshes	Seeds, some insects
California mouse	Peromyscus californicus	Live-oaks and dense chaparral	Acorns
Deer mouse	Peromyscus maniculatus	Nearly every dryland habitat within its range is occupied - forest, grasslands, etc.	Seeds, nuts, acorns, insects

Brush mouse	Peromyscus boylei	Chaparral areas of arid and semi-arid regions; rocky situations	Pine nuts, acorns, seeds, berries
Piñon mouse	Peromyscus truei	Rocky terrain with scattered piñon and junipers	Seeds and nuts
Southern grasshopper mouse	Onychomys torridus	Prairies; open country; grass, sagebrush, grease-wood; sandy or gravelly soils	Insects, scorpions, other mice, lizards; some seeds
Desert woodrat	Neotoma lepida	Desert floors or rocky slopes with scattered cactus, yucca, or other vegetation	Seeds, fruits, acorns, cactus
Dusky-footed woodrat	Neotoma fuscipes	Heavy chaparral, stream-side thickets, deciduous or mixed woods	Seeds, nuts, acorns, fruits, green vege-tation and fungi
Tree phenacomys	Phenacomys longicaudus	Spruce, hemlock, fir forests	Spruce, hemlock, and fir needles
California redback vole	Clethrionomys occidentalis	Moist, log-strewn forest floors	Green vegetation, seeds, nuts, bark, fungi; insects
California vole	Microtus californicus	Marshy ground, wet meadows, dry grassy hillsides	Grasses, sedges and other green vegetation
Muskrat	Ondatra zibethica	Fresh marshes, streams, rivers, ponds, lakes	Aquatic vegetation; clams, frogs, fish
Norway rat	Rattus norvegicus	Areas of human habitation	Anything edible
House mouse	Mus musculus	Areas of human habitation	Anything edible
Pacific jumping mouse	Zapus trinotatus	Wet, marshy areas, open meadows, woods	Seeds, fruits, insects

Porcupine	*Erethizon dorsatum*	Usually forested areas, occasionally in brush	Buds, small twigs, and inner bark of trees
		Lagomorphs	
Blacktail jackrabbit	*Lepus californicus*	Open prairies	Green vegetation
Desert cottontail	*Sylvilagus auduboni*	Open plains, foothills, low valleys, grass, sagebrush	Green vegetation
Brush rabbit	*Sylvilagus bachmani*	Chaparral or thick brush	Green vegetation
		Artiodactyls	
Wild boar/ feral pig	*Sus scrofa*	Chaparral, oak woodland, grassland, forests	Omnivorous
Elk	*Cervus canadensis*	Semi-open forests, mountain meadows; foothills, plains, valleys	Grasses, herbs, twigs, bark
Tule elk	*Cervus nannodes*	Semi-open forests, mountain meadows, foothills, plains, valleys	Grasses, herbs, twigs, bark
Black-tail deer	*Odocoileus hemionus columbianus*	Coniferous forests, chaparral, grassland with shrubs, browse plants necessary	Browses on shrubs and twigs - also grass and herbs
California mule deer	*Odocoloileus hemionus californicus*	Coniferous forests, chaparral, grassland with shrubs, browse plants necessary	Browses on shrubs and twigs - also grass and herbs

Compiled from: Burt and Grossenheider (1964) A Field Guide to the Mammals; California Fish and Wildlife Plan Vol. III, Part A (1965); Grinnell (1933) Review of the Recent Mammal Fauna of California; Ingles (1947) Mammals of California; "Vertebrate Check List for Hopland Field Station".

Table 11

MAMMALS WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Site Area								
	4	5	12	18	21	27	28	42	43
Opossum	x	x	x	x	x	x	x	x	x
Trowbridge shrew	x	*	*	x	x	x	x	x	x
Vagrant shrew				x	x				
Pacific shrew				x	x				
Ornate shrew	x	x	x	x	x	x	x	x	x
Suisun shrew	x								
Shrew-mole	x			x	x	x	x	x	x
California mole	x		x	x	x	x	x	x	x
Little brown myotis	x	x	x	x	x	x	x	x	x
Yuma myotis	x	x	x	x	x	x	x	x	x
Long-eared myotis	x	x	x	x	x	x	x	x	x
Fringed myotis	x	x	x	x	x	x	x	x	x
Long-legged myotis	x	x	x	x	x	x	x	x	x
California myotis	x	x	x	x	x	x	x	x	x
Small-footed myotis		*	*						*
Silver-haired bat	x	x	x	x	x	x	x	x	x
Western pipistrel	x	x	x			x	x	x	x
Big brown bat	x	x	x	x	x	x	x	x	x
Red bat	x	x	x	x	x	x	x	x	x
Hoary bat	x	x	x	x	x	x	x	x	x
Western big-eared bat	x	x	x	x	x	x	x	x	x
Pallid bat	x	x	x	x	x	x	x	x	x
Mexican freetail bat	x	x	x	x	x	x	x	x	x
Western mastiff bat			x			x	x		
Black bear				x	x				
Raccoon	x	x	x	x	x	x	x	x	x
Ringtail	x	x		x	x	x	x	*	*
Marten				*	*				
Fisher				*	*				
Shorttail weasel				x	x				
Longtail weasel	x	x	x	x	x	x	x	x	x
Mink	x	x	x	x	x			x	x
River otter	x	x	x	x	x			*	x
Sea otter				x			x		
Badger	x	x	x	x	x	x	x	x	x
Spotted skunk	x	x	x	x	x	x	x	x	x
Striped skunk	x	x	x	x	x	x	x	x	x
Coyote	x	x	x	x	x	x	x	x	x
Red fox		*	*						
Kit fox			x					*	*
Gray fox	x	x	x	x	x	x	x	x	x
Mountain lion		x		x	x	x			
Bobcat	x	x	x	x	x	x	x	x	x
Mountain beaver				x	x				
California ground squirrel	x	x	x	x	x	x	x	x	x

Common Name	Site Area 4	5	12	18	21	27	28	42	43
San Joaquin antelope squirrel			*						
Townsend chipmunk	*	x		x	x				
Sonoma chipmunk	*	x		x	x				
Merriam chipmunk			x			x	x		
Western gray squirrel	x	x	*	x	x	x	x	x	x
Chickaree		*		x	x				
Northern flying squirrel		*			*				
Valley pocket gopher	x	x	x	x	x	x	x	x	x
Little pocket mouse		*	x					*	*
San Joaquin pocket mouse			x					*	*
California pocket mouse	*		x			x	x	x	x
Heermann kangaroo rat	x	x	x	x	x			x	x
Giant kangaroo rat			x						
Santa Cruz kangaroo rat			x			x	x		
Big-eared kangaroo rat						*			
Fresno kangaroo rat			*						
Beaver	x	x	x					x	x
Western harvest house	x	x	x	x	x	x	x	x	x
Salt marsh harvest house	x							*	*
California mouse	x		x			x	x	x	x
Deer mouse	x	x	x	x	x	x	x	x	x
Brush mouse	x	x	x	x	*	x	x	x	x
Piñon mouse	x	x	x	x	x	x	x	x	x
Southern grasshopper mouse			x						
Desert woodrat			x			x		x	x
Dusky-footed woodrat	x	x	x	x	x	x	x	x	x
Tree phenacomys		x		x	x				
California redback vole		*			x				
California vole	x	x	x	x	x	x	x	x	x
Muskrat	x	x	x	x	x	x	x	x	x
Norway rat	x	x	x	x	x	x	x	x	x
House mouse	x	x	x	x	x	x	x	x	x
Pacific jumping mouse		*		x	x				
Porcupine		*			*				
Blacktail jackrabbit	x	x	x	x	x	x	x	x	x
Desert cottontail	x	x	x			x	x	x	x
Brush rabbit	x	x	x	x	x	x	x	x	x
Wild boar/ feral pig				x		x			
Elk	*			*	x				
Tule elk	*								
Blacktail deer	x	x	*	x	x	x	x	x	x
California mule deer			x						

x Probably occurs on the area.

* Limits of distribution poorly documented; presence of this species on the site is uncertain or questionable.

Table 12

RARE AND ENDANGERED VERTEBRATES WHOSE DISTRIBUTION INCLUDE THE WASTEWATER LAND APPLICATION STUDY SITES

Common Name	Scientific Name	Status FR	Status BSF&W	Status CAL	Occurrence, Site Area 4	5	12	18	21	27	28	42	43
Mammals													
Pine marten	Martes americana		U					*	*				
Fisher	Martes pennanti		U					*	*				
Southern sea otter	Enhydra lutris nereis		R					x			x		
San Joaquin kit fox	Vulpes macrotis mutica	E	E	R			x					*	*
Big-eared kangaroo rat	Dipodomys elephantinus		U							*			
Fresno kangaroo rat	Dipodomys nitratoides			R			*						
Salt marsh harvest mouse	Reithrodontomys raviventris	E	U	E	x							*	*
Birds													
California brown pelican	Pelecanus occidentalis californicus	E	U	E				x		x			
Wood ibis	Mycteria americana		P			x							
Aleutian Canada goose	Branta canadensis leucoparcia	E	E		*	*	*	*	*	*	*	*	*
Tule white-fronted goose	Anser albifrons gambelli		E		*	*	*	*	*	*	*	*	*
Red-bellied red-shouldered hawk	Buteo lineatus elegans		U		*	*	*	*	*	*	*	*	*
Ferruginous hawk	Buteo regalis		U		x	x	x	x	x	x	x	x	x
Southern bald eagle	Haliaeetus leucocephalus leucocephalus	E	E	E	*	*	x	x	x	*	x	*	*

Common Name	Scientific Name	Status FR	Status BSF&W	Status CAL	Occurrence, Site Area 4	5	12	18	21	27	28	42	43
American osprey	Pandion haliaetus carolinensis		U		x	x	x	x	x	x	x	x	x
Prairie falcon	Falco mexicanus		R		x	*	x	x	*	*		x	*
American peregrine falcon	Falco pergrinus anatum	E	E	E	x	*	x	x	x	*	x	*	*
Greater sandhill crane	Grus canadensis tabida		R			x	x	x				*	x
California clapper rail	Rallus longirostris obsoletus	E	R	E				x		x	x		
California black rail	Laterallus jamaicensis coturniculus		R	R	x			x		*	*		
Mountain plover	Eupoda montana		U			*	x	x	*			x	
Alaskan short billed dowitcher	Limnodromus griseus ssp.		U		*	*	*	*	*	*	*	*	*
California least tern	Sterna albifrons browni	E	E	E				x			x		
California yellow-billed cuckoo	Coccyzus americanus occidentalis			R		*	*	x	*	*		*	*
Northwestern tropical kingbird	Tyrannus melanocholicus ssp.		P					x			*		
Yakutat fox sparrow	Passerella iliaca meruloides		U		*	*	*	x	*	*	x	*	*
Samuel's song sparrow	Melospiza melodia samuelis		U		*								
Suisun song sparrow	Melospiza melodia maxillaris		U		x							x	x
Reptiles													
Blunt-nosed leopard lizard	Crotaphytus wislizenii silus	E	E	E			x			x			
Alameda striped racer	Masticophis lateralis euryxanthus			R	x	x	x	x	x	x	x	x	x

Common Name	Scientific Name	Status FR	Status BSF&W	Status CAL	Occurrence, Site Area 4	5	12	18	21	27	28	42	43
San Francisco garter snake	_Thamnophis sirtalis tetrataenia_	E	E	E							x		
Two-striped garter snake	_Thamnophis couchi hammondi_		U				*			*			
Giant garter snake	_Thamnophis couchi gigas_		U	R			x					x	x
Fish													
White sturgeon	_Acipenser transmontanus_		U		x	x		x	x			x	
Thicktail chub	_Gila crassicauda_		U	‡	x								x
Sacramento perch	_Archoplites interruptus_		U		x					x			x

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BSF&W Bureau of Sport Fisheries and Wildlife. _Rare and Endangered Fish and Wildlife of the United States_. 1968.

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E Endangered

R Rare

P Peripheral

U Status uncertain

x This species or subspecies definitely or probably occurs in the site area

* Occurrence of this species or subspecies in the site area is uncertain or questionable.

‡ Fully protected species, California Fish and Game Code, Art. 1, Sections 900-903; 3511; 4700; 5050; and 5152.

SECTION L

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